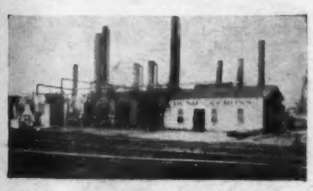
The REFINER

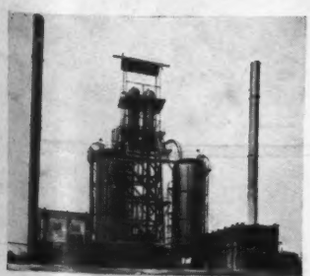
AND NATURAL GASOLINE MANUFACTURER

In tube still fire brick construction at Stoll Oil Refining Co., Louisville, Ky., ADAMANT Cement has given very satisfactory service.

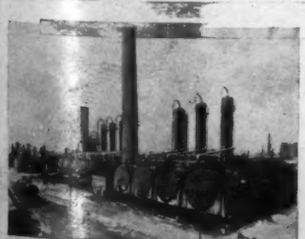
Every time a boiler or still setting is out of service in this refinery, the brickwork is surfaced with an ADAMANT-ADACHROME Mixture, blown on with The ADAMANT Gun (Price $25.00). Brick pores, cracks and joints are sealed, and the brickwork is highly-resistant to slags, sulphur and other impurities in fuel which cause fluxing, slagging or melting of brick.



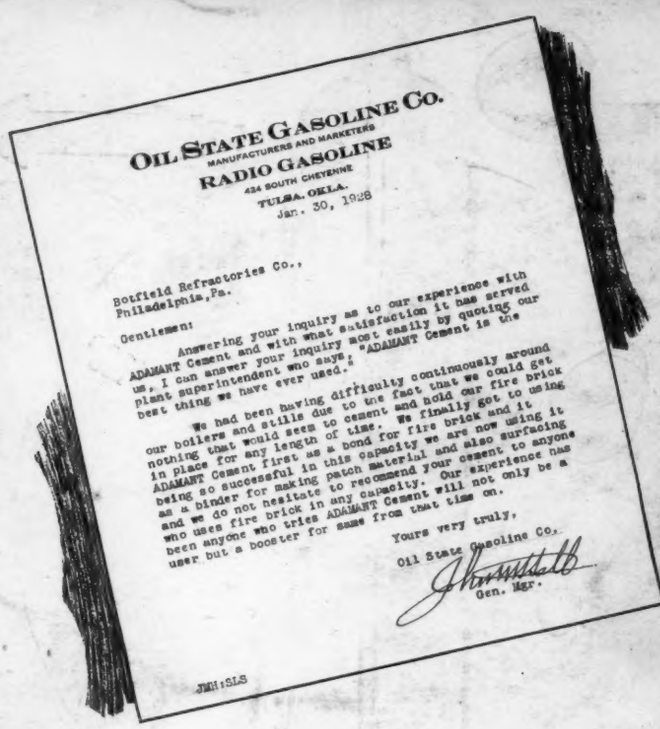
In still settings at Henry H. Cross Company's Smackover refinery, walls are "in much better shape" since ADAMANT Cement is used for laying up the fire brick.



On the fire-exposed walls of these Dubbs units in a mid-continent refinery, ADAMANT Cement has been used effectively as a protective coating.



In stills at The Paragon Refining Company, first brick construction is built with ADAMANT Cement.



OIL STATE GASOLINE CO.
MANUFACTURERS AND MARKETERS
RADIO GASOLINE
434 SOUTH CHEYENNE
TULSA, OKLA.
Jan. 30, 1928

Botfield Refractories Co.,
Philadelphia, Pa.

Gentlemen:

Answering your inquiry as to our experience with ADAMANT Cement and with what satisfaction it has served us, I can answer your inquiry most easily by quoting our plant superintendent who says, "ADAMANT Cement is the best thing we have ever used."

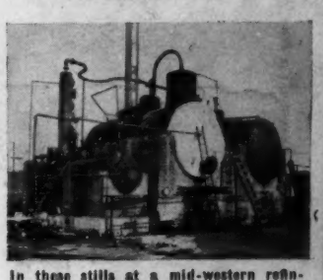
We had been having difficulty continuously around our boilers and stills due to the fact that we could get nothing that would seem to cement and hold our fire brick in place for any length of time. We finally got to using ADAMANT Cement first as a bond for fire brick and it being so successful in this capacity we are now using it as a binder for making patch material and also surfacing and we do not hesitate to recommend your cement to anyone who uses fire brick in any capacity. Our experience has been anyone who tries ADAMANT Cement will not only be a user but a booster for same from that time on.

Yours very truly,
Oil State Gasoline Co.
Gen. Mgr.

JMH:SLS

At the refinery of Simms Oil Company, Dallas, Texas, ADAMANT Fire Brick Cement has been used in building the refractory construction in stills and boiler furnaces.

This front wall in a Foster tube still has been given a protective coating of ADAMANT-ADACHROME, applied with The ADAMANT Gun.



In these stills at a mid-western refinery, settings last twice as long since they are built with ADAMANT Cement.

For Refinery Officials

FOR the refinery official interested in longer-lasting fire brick construction, there's a wealth of informative data in the "Petroleum Refineries" chapter of the new book on ADAMANT Fire Brick Cement. Write today for a copy, and also for data on the new Super-Refractory Mixtures of ADAMANT-ADACHROME *Fines* (for laying up brick) and ADAMANT-ADACHROME (for surfacing applications with the ADAMANT Gun), where pitting, corrosive or slagging conditions exist. Use the convenient coupon.

BOTFIELD REFRACTORIES CO.
Swanson and Clymer Sts.,
Philadelphia, Pa.

For A Long Furnace Run, Use The ADAMANT Gun

ADAMANT
FIRE BRICK CEMENT

Whenever You Use a Fire Brick, Use ADAMANT, the Original High Temperature Cement

BOTFIELD REFRACTORIES CO.

Swanson and Clymer Sts.,
Philadelphia, Pa.

Send a copy of the new ADAMANT book, and data on the Super-Refractory Mixtures.

Name

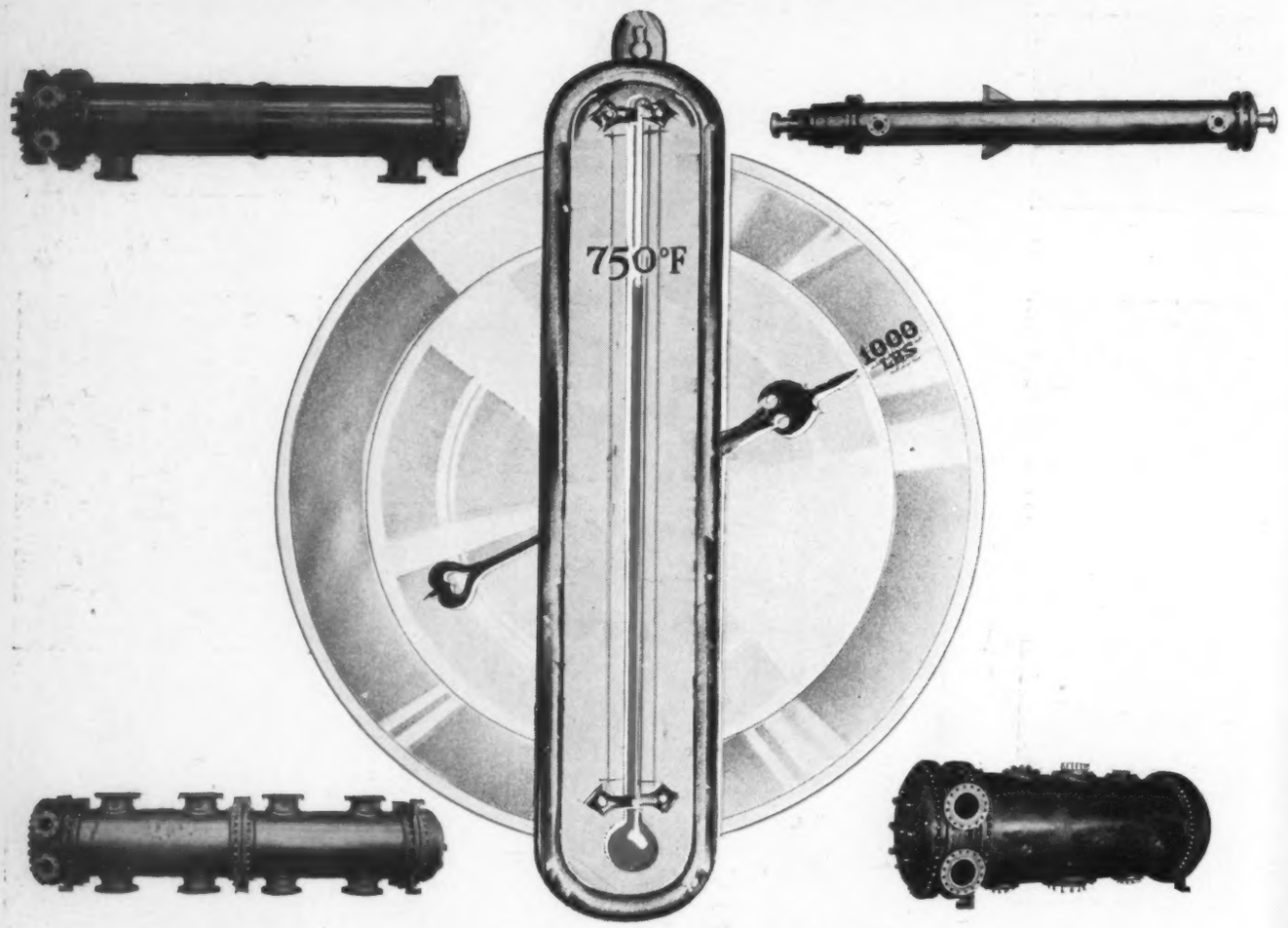
Company

Address

BRAUN

HIGH PRESSURE • HIGH TEMPERATURE

EXCHANGERS



FOR ALL SERVICES

C. F. BRAUN & CO.

MANUFACTURING MECHANICAL ENGINEERS

ALHAMBRA - CALIFORNIA

TULSA DALLAS NEW YORK

BRAUN

Entered as second class matter June 16th, 1923, at the Postoffice at Houston, Texas, under the act of March 3, 1879.

Vol. 7, No. 4 APRIL, 1928

The REFINER

AND NATURAL GASOLINE MANUFACTURER

Edited Monthly at Tulsa, Oklahoma

GRADY TRIPLETT, *Editor* GEORGE REID, *Associate Editor*

TABLE OF CONTENTS

PROFIT IS POSSIBLE 53
An Editorial by Grady Triplett

WHAT IS THE CONTROLLING FACTOR IN THE GASOLINE MARKET? 55
By E. P. Angus

VAPOR PHASE CRACKING INTERESTS REFINERS 56

HUMAN ENGINEERING 57
By Hubert A. Ross

GETTING 40 PER CENT. MOTOR FUEL FROM SMACKOVER CRUDE 60
By George Reid

ESSENTIAL TREATING DETAILS FOR THE HYPOCHLORITE METHOD 63
By W. R. Hounsell

RELATION OF NATURAL GASOLINE TO REFINERIES 65
By Bernard O'Connor

LONG BEACH GASOLINE PLANT IS UP-TO-DATE EQUIPMENT 67
By Brad Mills

CLAYS—AND THEIR APPLICATION IN REFINING 69
By George W. Cupit

CHEMICAL CONTROL OF GREASE MANUFACTURE 72
By C. B. Faught and F. R. Staley

EFFECT OF SIZE AND SHAPE OF FILTER ON PERCOLATION FILTRATION 74
By H. L. Kauffman

CASINGHEAD GAS CONTRACTING 78
By T. R. Goebel

TREATING CALIFORNIA STRAIGHT-RUN GASOLINE 80
By E. N. Klemgard

ACID SLUDGE PROBLEM IN OIL REFINING 88
By J. B. Rather

TECHNICAL CONTROL OF REFINERY PROCESSES 91
By E. B. Phillips and Albert E. Miller

THE REFINERY SLUDGE PROBLEM 104
By L. L. Davis

PROPER INSULATION FOR REFINERIES 107
By H. S. Bell

NEW EQUIPMENT 110
REFINERY AND GASOLINE PLANT ACTIVITIES 112
ABSTRACTS OF REFINERY TECHNOLOGY 124

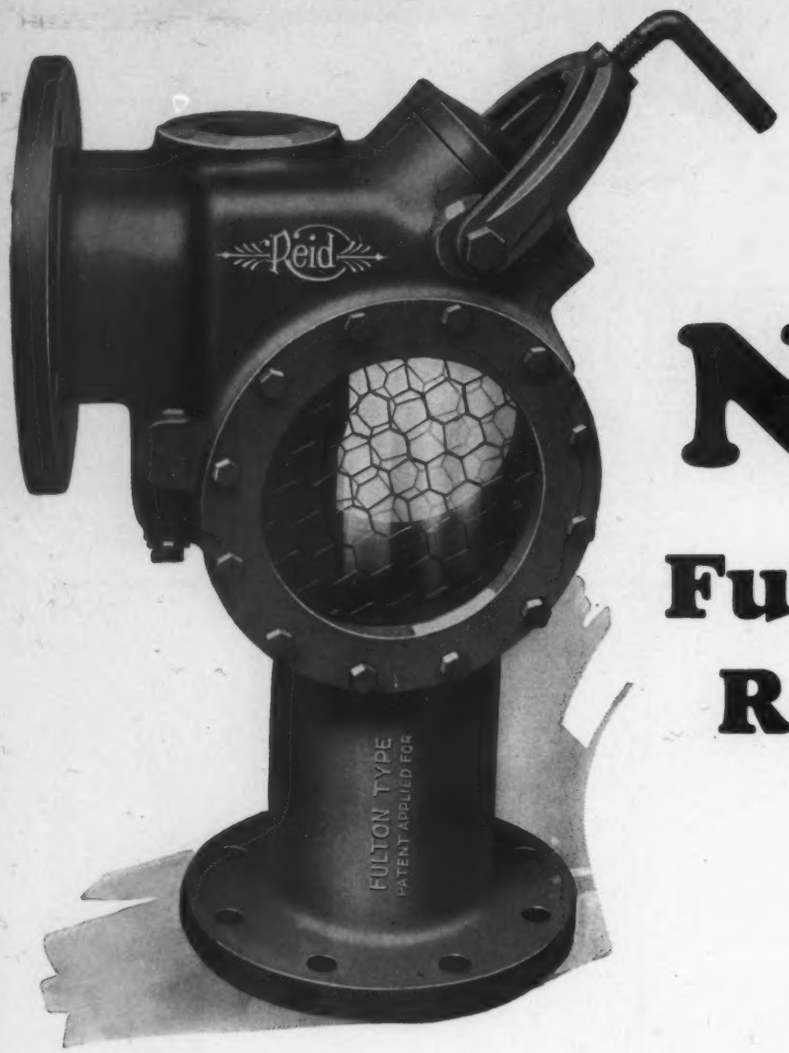
Published Monthly by GULF PUBLISHING COMPANY
Copyrighted, 1927

R. L. DUDLEY, *President* — A. L. BURNS, *General Manager* — SPENCER W. ROBINSON, *Editorial Director* — J. KENT RIDLEY, *Managing Editor*

Editorial Office: 214-218 Atco Building, Tulsa, Oklahoma

Office of Publication: 3301 Buffalo Drive, Houston, Texas

NEW YORK: Room 832, 250 Park Avenue, R. P. Swinsky, Manager. *PITTSBURGH*: 510 Park Bldg., W. W. Pigue, Manager. *CHICAGO*: 476 First National Bank Bldg., O. R. Waller, Manager. *LOS ANGELES*: 416-417 Haas Bldg., Wm. V. Gross, Manager. *TULSA*: 214-218 Atco Bldg., J. F. Carter, Jr., Manager. *FORT WORTH*: 203 W. T. Waggoner Bldg., H. H. King, Manager. Single copies 20 cents. Domestic Subscription price, $1.00 a year. Foreign Subscription price $1.50 a year. Advertising rates upon application.



The

NEW

Fulton Type Receiving Box

The Fulton Type Receiving Box has several new features, including an oil pocket from which samples of oil passing through the box can be taken without opening the box.

Write for Bulletin No. 38

JOSEPH REID GAS ENGINE COMPANY
OIL CITY, PENNSYLVANIA, U. S. A.

Western Representative: Frick-Reid Supply Co., Tulsa, Okla.
Export Representative: Oil Field Equipment Co., Inc., 30 Church Street, New York City, U. S. A.

REID REFINERY EQUIPMENT

Profit Is Possible

IT is within the province of a dozen refining concerns to bring gasoline prices up to a profit-making figure within 60 days.

No selected list of refineries is essential to the effort. It is not necessary that exactly 12 concerns be involved. The effort will not require collusion. Price-fixing need not be approached.

If a half dozen, a dozen or a score of concerns, whose total daily refining capacity is around 100,000 barrels, will each put its own plant operation and its own sales effort on a profit-making basis, the whole refinery gasoline market will respond within 60 days.

Simple business methods are all that is essential. First calculations should be made to determine just what each concern can expect to sell at a profit over six months. Then plant runs, considered in the light of present gasoline stocks, should be adjusted to fill the indicated demand.

Next the cost of making that gasoline should be determined with exactness. To that cost, adequate profit should be added.

These two, cost and profit, should then become the gasoline price for each concern.

The one essential to the whole plan is that each concern sell its gasoline at one price, the profit-making price, determined by honest calculation.

Prices thus determined will be so nearly identical that variations will be of little consequence. These trivial price differences should be of such little consequence that no sales manager would look on figures lower than his as meaning that he should adjust his figures to meet those below his price.

The gasoline output from enough plants to include 100,000 barrels daily runs is sufficient to lead the market. With that much gasoline off the market for a month and buyers would be looking for gasoline. The price under that condition would move upward.

Adjusting the price on the gasoline from 100,000 barrels of daily refining capacity will not remove that much gasoline from the market. But it will remove it from the present price level.

Consequently, buyers will be forced to look for gasoline and the only place it will be found will be within the profit-making circle. If those within this charmed circle will hold to profit-making figures, these buyers will be forced to pay accordingly.

By holding that condition for 60 days, the whole gasoline market will move upward. When buyers begin to search for merchandise, prices are bound to advance. The chief trouble with the present refinery gasoline market is that sellers are laying their product at the mercy of buyers.

All this is not theory. A few concerns are holding prices above the common f. o. b. price on gasoline. Furthermore, these concerns are receiving higher prices than accepted quotations. These concerns may not be receiving what gasoline is really worth, as determined by cost and fair profit.

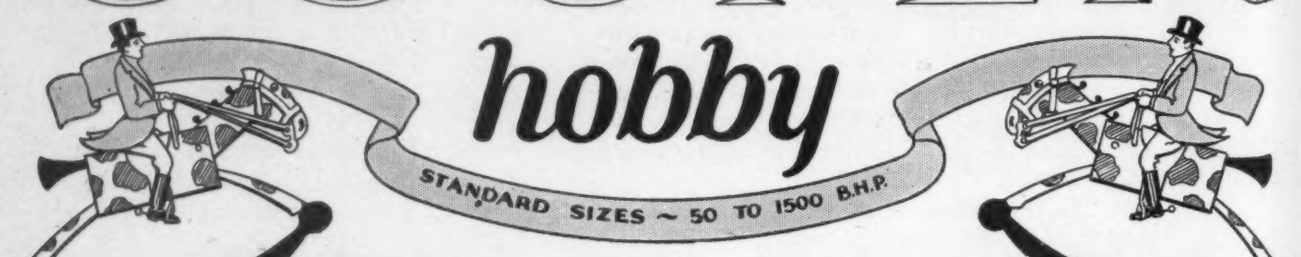
But the fact that they are selling above common quotations is evidence that other concerns can do likewise. With a dozen or a score of substantial independent refining concerns demanding profit on gasoline, betterment is the certain result.

The chief requirement is courage. Courage should be mixed into two phases of the effort. It will take courage to restrict runs to what is certain to be sold. More courage will be required to hold prices at the profit-making level.

And this profit-making price should be just one price. The buyer of one car of gasoline should know he is buying at the same figure as the man who buys a dozen cars. That sort of selling will build confidence. No other brand of selling will.

Grady Gilbert

For wealth and health it pays to ride the COOPER hobby

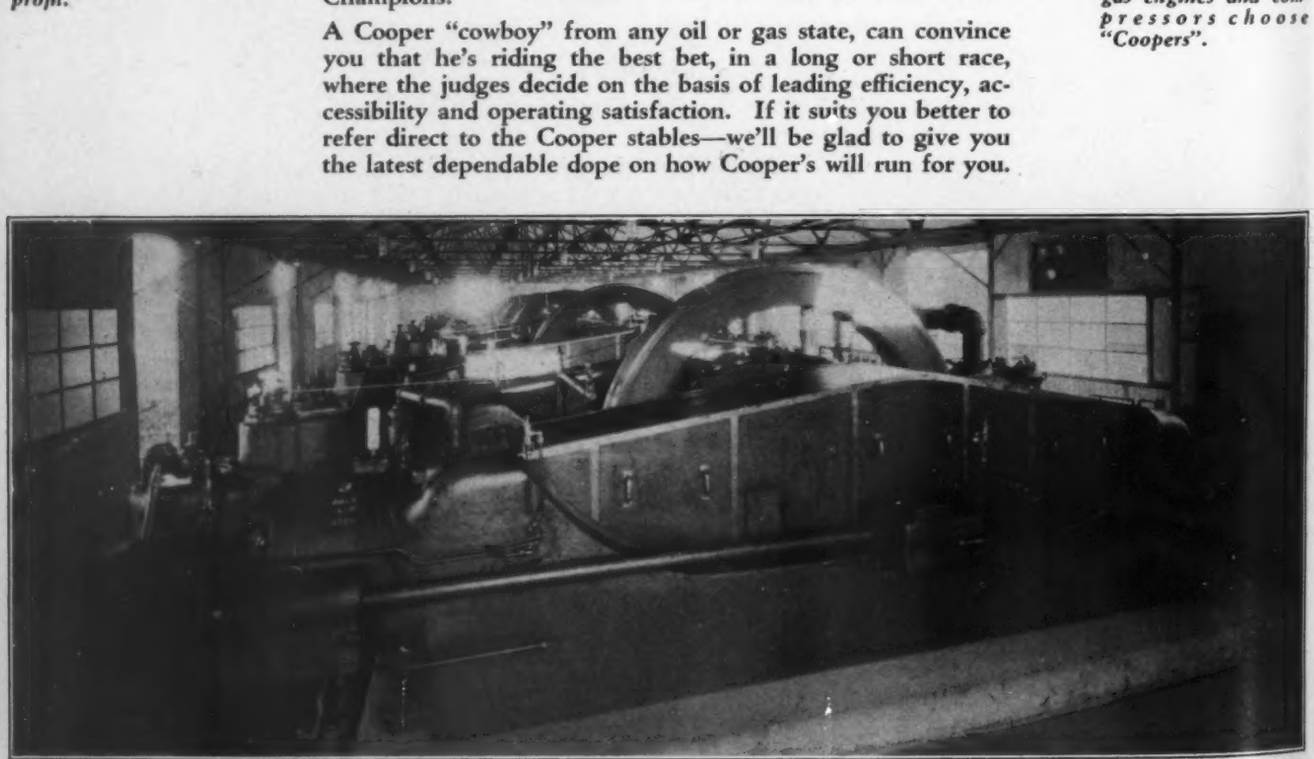


In many a natural gasoline plant the economies resulting from operating Cooper engines very nearly represent the profit.

You will find men throughout the realm of oil and gas who have had the hobby of Cooper Engines and Compressors since they got their first job as engine room grooms. And, likewise, other men, who though never actually experienced in the operation of Coopers, have lived with engine performance, cost and up-keep records long enough to appreciate the better paces Coopers have shown them. To the men who have the Cooper hobby—and their number is growing at a greate rate—Coopers are the Cost-Cutting Blue-Ribbon Champions.

A Cooper "cowboy" from any oil or gas state, can convince you that he's riding the best bet, in a long or short race, where the judges decide on the basis of leading efficiency, accessibility and operating satisfaction. If it suits you better to refer direct to the Cooper stables—we'll be glad to give you the latest dependable dope on how Cooper's will run for you.

Men live longer and happier if they can avoid worry. Every year more and more of them who have anything to do with gas engines and compressors choose "Coopers".



The C. & G. COOPER COMPANY

Dallas, Texas Mt. Vernon, Ohio Los Angeles, Calif. Tulsa, Okla.

Mention Where You Saw the Advertisement

What is the Controlling Factor in the Gasoline Market

By E. P. ANGUS

AT the present time the only recognized market on gasoline is that current price which is obtained for gasoline in tank car lots f. o. b. refinery points particularly, and in cargo lots at seaboard. The percentage of the volume of the total gasoline consumption in the States handled by distributors owning refineries, is not known, but it is understood to be quite a large percentage of the total. The market on that portion of the gasoline is not based so much on the current tank car prices at refinery points, since sale of this gasoline from the original owner is on a tank wagon basis, and a certain per cent of the gasoline sold by refineries to non-refining jobbers is on a basis of so much under the prevailing tank wagon market at points of destination. The present tank car market, therefore, is based largely on current sales of spot shipments on a comparatively small part of the total gasoline output.

Under the present general plan of marketing gasoline, in most localities there is a certain definite spread between the tank wagon price and the service station, or retail price—in some localities it is two cents, in some three cents, in some four cents and as high as six cents. This spread often continues regardless of any advance or decline in the market price, whether it be tank car, tank wagon or service station. Many non-refining jobbers purchasing through brokers, or direct from the refining jobpanies, purchase under some kind of guaranteed or marginal contract, which margin between delivered cost to the jobber and the current tank wagon price, remains the same, whether it be three, four or four and one-half cents, irrespective of advance or decline in either tank wagon or service station retail prices. Under this plan of marketing, there is no incentive to the dealer who buys from tank wagon or the jobber who buys in tank cars to uphold a reasonable and profitable price, so that the refiner, the jobber or the distributor will also be able to secure a reasonable profit. Many cases in recent years have developed where, under a guaranteed margin, whether it be to the dealer or the jobber purchasing in tank cars, resulted in a net back to the refining company one to four cents under what may be regarded as the tank car market.

It is recognized that many men are thinking on the subject of some plan that will assist, or be helpful, in remedying some of the present and recent past problems of the industry. It is not likely that any plan can be suggested, or adopted, that will cure all of the ills. There is too much varied interests for the industry to take up and adopt any particular plan for basing a market, but it is obvious that some movement should be made in a direction which would work in a practical way to eliminate some of the causes of the unnecessary and unbusinesslike local price fluctuations. To that end, the following plan is offered, merely to be considered and studied with a view of forming a definite sentiment toward some action that will tend to improve the present (and past) difficulties:

THE plan is that the distributor, whether he makes his own gasoline or purchases from other refineries in tank car lots, should maintain a retail price on his product, and that price be considered, exclusive of the excise or other tax; that the sales then made to the dealer should be billed at retail price, less a certain per cent discount. For practical illustration, we will say that the distributor's retail price today is 15 cents, plus tax, and his discount to his dealer is 20 per cent, the dealer's discount in this case would be three cents, which is approximately the average over the country today. If the distributor's schedule should be advanced to 17 cents, plus tax, based on advance of crude or otherwise, then the 20 per cent would equal 3.4 cents spread for his dealer. On the other hand, if the schedule is reduced to 12 cents, the 20 per cent would equal 2.40 cents per gallon; if reduced to 10 cents, the dealer's gross margin would be two cents; if the retail price advanced to 20 cents the spread would be four cents to the dealer. In this way there would be an incentive for the dealer to rather encourage the maintenance of a reasonably profitable market for the distributor or the refiner. If the dealer was inclined to cut retail prices and his competitive dealers were to follow his lead, they would all find, under this plan, a lessening of their margin.

Carrying this plan further, if the refinery selling to the jobber in a particular locality were to take the prevailing retail price in that locality as his selling price and deliver the gasoline in tank cars, and instead of guaranteeing a three cents or four cents margin under current tank wagon prices, he were to allow his jobber a discount of 20 per cent, and 25 per cent under the prevailing retail price, exclusive of tax, then under a 20 cents retail price, the dealer would get four cents, the jobber would get the same 20 per rent plus an additional 25 per cent, equalling four cents under the

dealer's price, or a total of 8 cents under the 20 cents retail price, and would net the refinery 12 cents delivered. If the retail price was 15 cents the first discount 20 per cent, equalling three cents, the second discount of 25 per cent would equal three cents, and the refiner would get nine cents for his product delivered in tank cars; then if the retail price was 10 cents, the dealer's 20 per cent would equal two cents, the additional 25 per cent to the jobber would equal two cents, and the refiner would get six cents. In this same 10 cents retail schedule, if the present margins were guaranteed, i.e., the dealer three cents and the jobber four cents, the refiner would only get three cents delivered, which, after deducting freight, may leave him one and one-half or two cents. These discounts are merely used to indicate the principle of the percentage basis of discounting, whether it be 20 and 25 or some other figures.

Going further than this, distributors maintaining wholesale stations operating the same on commission basis, should work out a percentage basis commission for their agents, plus a reasonable cartage allowance, if desirable for long distance hauls, but letting the percentage commission of, say, 10 per cent be the basis and that applying on the net price to the dealer after the 20 per cent, or some such discount, is made from the original retail schedule. This, then, would carry the plan to a point where all parties concerned would be interested in avoiding local destructive price wars, which reflects back in the end to the producer of crude. It may be remarked here that every person or firm interested in the production of crude oil, or interested directly or indirectly in furnishing equipment or supplies to producers or refiners or distributors, is affected to a more or less extent by the price that "Lizzie" pays to have her tank filled at the service station, for after capital money has been spent, all new money, practically speaking, that goes back into the business is that money which "Lizzie" pays "Jimmie" at the service station. A stable and reasonable service station price is therefore a thing to be desired and encouraged by all parties interested directly or indirectly in the petroleum industry.

Vapor Phase Cracking Interests Refiners

THE possibilities of vapor phase cracking systems and processes are attracting widespread attention among refiners. The chief reason for present interest lies in the fact that the product of the vapor phase cracking process has been found in most instances to possess such marked antiknock properties as to be exceptionally valuable in the blending and compounding of premium motor fuels. Mr. H. C. Parmelee writing in Chemical and Metallurgical Engineering, Vol. 35, No. 1, issue of January, 1928, among other interesting and valuable remarks on the subject, has the following to say:

"Some progress has been made during the past year in perhaps a half-dozen oil refineries, but if vapor phase cracking is to be widely adopted, there are economic, technical and perhaps legal difficulties to be met. Inherent characteristics of the process that have until recently appeared as disandvantages are the high yield of non-condensible gas and the production of a gasoline difficult to refine because of its higher content of unsaturated and gum-forming compounds. Fortunately the gas is of high B.t.u. value and if it were possible to sell it instead of gas oil to a neighboring gas company for enriching water gas, it should have commensurate value. The non-condensible gas also offers inviting opportunity for the recovery of alcohols and related solvents that are beginning to find an outlet in the lacquer industry. Promising research work in connection with the production and application of these alcohols has been under way.

'The refining problem of producing a water-white gasoline from a vapor phase cracking plant is not especially serious in these days of green, blue and red motor fuels, although it is apparent old methods are not entirely applicable. Fortunately the industry has shown unusual willingness to study and adopt radically new treating methods. Mechanical difficulties arise principally from the fact that much higher temperatures are required. With good engineering design, however, and the selection of the proper materials of construction, it is believed that the mechanical aspects of the problem can be satisfactorily handled. The remaining obstacle is the question of patents. Admittedly it is complicated but an industry that has spent most of the last ten years in patent litigation is not likely to be easily discouraged on this score."

In the matter of difficulties met with in refining the production of gasoline from the vapor phase system an interesting comment on this subject occurs in the same journal, issue of February, 1928. Donald M. Liddell, Consulting Engineer, New York City, writing to the editor of Chemical and Metallurgical Engineering points out that the refining of vapor phase gasoline in the vapor phase will overcome whatever obstacles may appear in the matter of such gum-forming constituents as may occur in vapor phase gasolines. Since the question of chemical treatment of vapor phase cracked gasolines is one of more or less interest to the refining industry, Mr. Liddell is quoted below:

"Noting your remark on page 44 of the January, 1928, issue that one of the inherent disadvantages of vapor-phase cracking was 'the production of a gasoline difficult to refine because of its higher content of unsaturated and gum-forming compounds,' I would suggest that the answer to this problem in vapor-phase cracking is vapor-phase refining. (See Chem. & Met., Dec. 22, 1924, pages 975-6.) There is no difficulty with vapor-phase cracked gasolines in vapor-phase refining."

Human Engineering

A neglected manufacturing phase of the Petroleum Industry in the Prevention of Waste

By HERBERT A. ROSS*
Steam and Combustion Engineer for the National Petroleum Association

OVER the signature of the editor, Grady Triplett, in the January, 1928, impression of this magazine, page 53, will be found a short but terse editorial, entitled "The Laggard."

It is only within the past year or two that contemporaneous ideas found not only in this magazine, but in other trade publications as well, with one accord, are devoting unlimited columns to the problem of "Increased Profits" that are believed possible of attainment in the refining of crude petroleum.

The inspiration of these ideas is found in the fact that the refiner is up against a proposition of over-production that affects his very existence as a profitable enterprise.

The summation of all the theories advanced is, that in order to increase profit, two avenues of procedure are today available.

The first and most important one, is that of reduced manufacturing cost in its many ramifications. The second is the establishment of such scientific research as will develop the universal consumption of petroleum derivatives hitherto unthought or unheard of. The profit that has already been derived from the manufacture of pharmaceutical preparations, and industrial solvents alone, is a concrete evidence of the value to be derived from such research in the further extension of additional uses.

Applied in unstinted measure to the problems of the industry today will be found capital, business management in production, manufacture, and sales, unlimited engineering development and scientific research, all striving for that common goal, "The Eldorado of Profit."

Side Shows

It may appear to be a far fetched illustration, but in the turmoil of conflicting ideas and theories pertaining to a diagnosis of the industries' ills, one cannot help but find an analogy in the "Midway" of a county fair.

Leading up to the entrance of the "Big Top" there is usually found an avenue lined with little booths. Each proprietor of these enterprises has something to sell that he warrants will afford the necessary requisite to derive the one "big kick" that awaits your arrival in the "main show tent" just ahead. Thus, accordingly, as we make our selections of and investments in toy balloons, whistles, or "what have you," proportional thereto will be our realization of profit upon arrival.

This illustration must not be taken as a disparagement of effort in any particular, for it is only used as a bit of conceit in order to emphasize the fact that this industry has its own "Main Street" of theory and effort, just as others have. Furthermore, the author of this article desires to set up his "little booth" with his fellows along this "Midway" and offer in brief manner a remedy for one of the very big manufacturing ills of the industry—namely *Waste*—that is paradoxically most conspicuous by the small amount of consideration and attention given it.

WHO has written or read of psychology as it specifically applies to the man in the petroleum industry? There are volumes to be found on every hand, dealing with this subject in general terms, and by common consent we accord it certain merit in the great scheme of business. Our evaluation of its importance, however, will to a great extent be modified by our own personal reactions to worthwhile things of life, not entirely represented by the acquisition of the dollar. It is a profound fact that as the moral concept of the human being is broadened and his vision of responsibilities is enlarged, monetary profit is the inevitable result. This is amply substantiated by the already tremendous wealth of this comparatively young nation of ours, that has so far out-paced the older civilization for no other reason than that we have consciously or unsciously advanced in the art of "Human Engineering."

The term "Human Engineering" may not be entirely correct. The idea it is desired to convey is that research or effort which is necessary to the development of the human mind so that it may be lifted from the drudgery of physical effort by the process of clear thinking and intelligent procedure, in order to economically accomplish the purpose of the scientist and the engineer.

Restricted Vision

In past centuries mankind gained its wealth and built its temples with the labor of its slaves. This labor was always controlled by the overseer or master mind. Thus we have the example of the many minds obeying the will of the one master mind. Even in our own recent history and so short a while ago as the civil war, many obtained their wealth also through the effort of the slave.

Today we do not term the human machine a slave, we say the slave is no more. But is this a fact? Rather, isn't it the case, that employed in the industry at the present time there are literally thousands of human machines who are freemen only to the extent that they go or come as they choose during certain hours of the day, but during certain other hours are chained to their tasks just as definitely as was the slave to his oar in the galley? Their job affords them a means of existence and their vision extends no farther than this. If the situation does not suit them they can quit their job and find another, or starve.

Very true, modern industry has its welfare departments, medical clinics, and other industrial relation activities between employer and employe. A number of industries also maintain schools for the instruction of their employes in the mechanics of their business. Some refineries may be active in these particulars also, but how many of them are spending the effort and money to develop the type of mind capable of avoiding waste and at the same time co-ordinating their tremendous investment in equipment, the design of the engineer, and the research of the scientist into an economical and efficient operating machine that will afford a profit.

The specialized mechanics of the industry today would be an utter failure if it were not for the fact that the engineer has designed the automaton to control the equipment he has developed. The pure scientist with his philosophy having first conceived the possibility. The outcome of this concerted effort is the "Robot," a new word recently coined, the literal meaning of which, is the slave that performs or functions as a substitute for the human, but without his brain or soul. Today we guide the ship, the airplaine, and the automobile with the "Robot." In the refining industry specifically, we fractionate with the aid of the "Robot" and perform many other related, complicated processes.

Back to the Man

The engineer can usually predicate with certainty the mechanical behavior of the

*Member American Society of Mechanical Engineers.

machine or the automaton which he designs. If it does not function as he wishes, he can change a link or wire where it is found necessary to do so, or for that matter, can rebuild the entire outfit and accomplish his purpose. There is one definite thing he cannot do, however, and that is, provide his machine with a soul. The ultimate success of his effort is absolutely dependent upon the incalculable equation of "human behavior."

The application of science to the welfare of mankind is today far in advance of man's ability to use it, either wisely or economically, so that in many instances the scientific theories or products of man's brains are complete failures only because the human link needed to co-ordinate the technical and the practical is missing. When capital in industry attains a full realization that it can never hope to mechanize the human mind or endow the "Robot" with a soul, material profit may be confidently anticipated.

As was previously stated and here again emphasized, the human slave laboring for a mere existence is no more. He has been replaced by a higher order of intelligence that has been afforded the material requirements of life which satisfy his physical needs. This change in the status of the human has been made possible by the capitalist, the scientist, and the engineer in their quest of profit and wealth. This "quest" has not been inspired entirely by altruistic motives, either, but in order to accomplish this purpose of profit attainment, it was found necessary to develop a higher order of mass intelligence. Thus the slave has been uplifted and placed on a higher plane of existence.

Mass production today is the direct outcome of mass intelligence that has been engendered and fostered by the techical profit seeking mind.

Profits in Men

Dwindling profits in many instances are new a serious matter because of overproduction. Capital still demands its profit. The scientist and engineer, in order to acquire their share also, and satisfy the demand, are working overtime to further develop the machine and its "Robot." What about the human behavior which must co-ordinate all this? It is this being developed in step with, and as rapidly as the machine?

In this country of ours so richly endowed with natural resources, we have, through unremitting effort in the exploitation of these resources and also the waste of them, established standards of life that have afforded the most humble industrious citizen every requisite to his material comfort. In addition to this, the average man has had unlimited opportunity to develop a personality by the process of education. The net result of all this is a human mechanism of individuality and soul that is demanding an opportunity to acquire its share of profit through the effort of its labor and the expression of its individuality. This human machine no longer accepts unprotestingly what is supposed to be correct. He no longer requires some other individual to do all of his thinking for him, for he is a force of mighty aspiration that can neither be denied or ignored, but he is also a natural born "waster."

Has industry now arrived at the crossroads of success or failure? In many instances it solicits the savings which the human machine has thriftily accumulated in order to further extend its activities. At the same time, however, it assures and reserves to itself, through the might of capital, an absolute right to control the human resources it absorbs. Assuredly! If any industry desires and insists upon control of the resources of the "human machine," it must by the same argument assume the responsibility for "human behavior" in its enterprises, or ultimate failure will be the inevitable result.

Ernest Martin Hopkins, President of Dartmouth College, in an article entitled "Faith of the Fathers," published in Scribner's Magazine, February 28, makes the following statement: "The greatest problem of our time is how we are to adjust ourselves with the necessary promptness to the rapidly changing conditions of life. The success of American industrial life, more than upon any other principle, has been founded on the flexibility of the American business man's mind, by which he has been willing to demolish his factory, to junk his mechanical equipment, or to re-devise his complicated processes of manufacture, when by so doing he could replace these more efficiently. Yet the analogy seems to be lost upon us when one attempts to persuade us to apply the principles to social usages, political organizations, educational procedures, or religious objective. At once appeal is made for holding to the faith of the fathers. All of the forces of censorship, repression, and prohibition are set in motion to preserve the theory that "Whatever is" is better than anything that might conceivably be.

Key Men

The foregoing paragraphs have been written solely as an argument, in order to establish the necessity for a more extensive adventure in the development of the art of "Human Engineering." Those that follow are based on personal observation and experiment, in an attempt to prove the value of such attempt.

Two outstanding facts, however, must first be definitely understood. These are: (a) that a successful industry must employ the human machine that affords the technical and college trained behavior; (b) that it must also employ the human machine that provides the practical behavior which produces the profit. Obviously this industrial condition will remain in status quo so long as life exists, therefore there is a necessity for still another type of human machine whose behavior will co-ordinate the two extremes of (a) and (b) into a profitable industrial enterprise.

This co-ordinating and co-operating medium is found in the superintendent or foreman who is in active control, intimate association, and personal contact with the producing and non-producing "human machine." He is the "key man" upon whose shoulders rests the greatest responsibilities, and in large measure, upon whose behavior the desired profit will be dependent.

The successful "key man" is not a slave driver, frequently he is not college educated. Through long years of practical experience in the plant, together with his daily contacts in the fields of administration and engineering, and this association in turn reinforced by a study of his particular problems presented through the medium of the trade magazine, has produced in him a concept of his position which is not entirely materialistic, and yet to say the least, he knows above everything else that it is up to him to produce the goods.

Specifications

The important problem then, is how we may best further develop this peculiar type of human behavior. It may be taken for granted that in our choice of the "key man" we will, or we should first canvass the entire personnel within our particular organization, in order to find the individual who best meets the following specifications:

A. *Experience.*—Evidenced and proven by the practical and profitable results he has produced.

B. *Loyalty.*—Exemplified by years of faithful service.

C. *Intelligence.*—An ability to understand the technicalities of his business, and to properly absorb and evaluate new ideas. Not necessarily blind adherence to old ideals, or obedience to established procedure that he honestly believes to be either untrue or incorrect.

D. *Spirit.*—Toleration for and with the right of a fellow man to his own individual ideas.

E. *Courage.*—To fearlessly express his opinion regardless of criticism, until he is convinced that he is in error.

F. *Faith.*—Confidence in not only his own ability, but also that of his fellow man's, to accomplish the allotted task under any and all circumstances.

G. *Personality.*—The ability to inspire the confidence of both the employer and employee in his integrity of purpose under all circumstances.

H. *Enthusiasm.*—That inspiration which affords the urge to accomplishment, regardless of previous failure or adverse circumstance.

I. *Idealism.*—Finally an adaptable human machine in a continual state of transformation in conformity with modern advancement in the arts and sciences of his business, holding to the ideal of greater achievement for himself and his fellow man, in order that both material and spiritual advancement may not only obtain for the present but be handed down as a heritage to those that follow us.

Men Already Know

The foregoing requirements are admittedly ideal, at the same time if the

enquiring executive will take the time to investigate and study his "key man" he will be astonished to learn how closely this individual already conforms to the specifications.

This human machine, the "key man" may not understand all of the refinements of business as it applies to organization, barter in buying or selling, or the technicalities of science and engineering. He does, however, usually have an intelligent concept of economic manufacturing procedure as it pertains to his particular job of production. Furthermore, it will generally be found that he has that invaluable quality of adaptability to the ever changing tendencies of modern manufacturing, which assists him to maintain the pace.

The petroleum industry is not different from any other in that its profit is absolutely dependent upon its cost of manufacture. In many instances heretofore, the executive in this particular industry has had the misguided notion that mass production, otherwise known as throughput volume, was the one big factor that affected the cost to manufacture the unit. This attitude has afforded the industry untold loss. Fortunes are today being lost because of over-production. This statement may not accord with the ideas of some individuals, but in any case, where volume production affords a glutted market that is capable of absorbing only a given output, it is most certainly obvious that some means, other than this mass procedure, must be undertaken to obtain profit.

Ideas as to what this means maybe will undoubtedly differ, and most certainly every one has a right to his own opinion. Such being a fact, the author herewith states one also. This opinion has been derived from the economic survey of a number of refineries, the intimate contacts with the "key man" and the profitable results amounting to hundreds of thousands of dollars annually, which have been obtained through his—the "key man's"—co-operation in the recommendations that have been made to avoid waste.

Its Money Value

The elimination of waste is a predominating need in the profitable conduct of the petroleum industry today. In large measure this waste is the outcome of effort to produce a profit by means of the aforesaid volume of production which entailed unusually heavy investment for special equipment that is today either obsolete or cannot be profitably continued in operation. Fortunes have been wasted in the production of and utilization of heat. Fortune have been lost in wasted energy in every departmental operating activity. Economies that will abate waste and afford profit can be attained through the efforts of the "key man" and his inspirational behavior to his superior, his subordinate and his job.

Here is the value of "human engineering" in its psychological and practical application to the industry. Fundamentally it means that attitude and disposition upon the part of management, that is willing to systematically afford the "key man" at regular intervals, information relative to the most intimate and confidential details pertaining to the costs for which he is responsible. This, of course, pre-supposes that management itself is thus informed.

Unfortunately, in the yesterdays of the industry it was generally considered a wise business policy to withhold all information or any other related confidential matters pertinent thereto, from the individual directly responsible for them. This disposition may have been entirely proper when competition was not so keen as now, and the attainment of profit was comparatively easy. A different condition of affairs obtains today, and economic progress in the avoidance of waste of every description is now of vital necessity.

Secrets Taboo

Evidence of this progress can only be had by comparisons of what is being done today projected upon the basis of what was done the previous day, month or year.

Afford information of this character to the "key man" and he is at once assisted in correcting the faults of the human behavior which is usually found to be the root of the evils of waste and its effect upon the cost of production. Do not expect him to produce economical results if he is not given information relative to the most intimate details of his departments.

Develop in him the spirit of co-operation to the fullest extent. This can only be acquired by according him the dignity and the courtesy which his position in the organization and his importance in the manufacturing structure warrants. If he has the merit to hold down the job with which he has been invested, he has the right to expect such treatment.

Undoubtedly there are same "key men" who are "round pegs in square holes." Usually, however, it will be found that the man himself is not blameable for such a situation. He has been invested with the authority of his position by the management, and such being the case the responsibility for a condition such as this rests entirely with the management. Furthermore, there is a moral obligation upon the part of the management to assist to the fullest extent, him who they exalt to such a position.

Men Before Science

This is "human engineering", and its influence upon the man in the responsible position and transferred by him to his subordinates, is the prime factor in the manufacturing cost structure. The value of such procedure is amply substantiated by the adventure of the National Petroleum Association in a pioneer effort to afford through its manufacturing committee, by co-operative means to a group of subscribing members, the technical supervision that would assist them to reduce their fuel bills.

This work was begun in September, 1925, and still continues. It is confined exclusively to studies and analysis in the production and utilization of heat. Quite naturally, before any value from this effort could be obtained, it was necessary to first sell the idea to the individual who would be responsible for the faithful conduct of any recommendations that were made. In many cases these recommendations meant that old ideas and methods of operating procedure would have to be discarded. In practically every instance this thankless task was saddled upon the already heavily laden shoulders of the "key man," in the guise of superintendent or foreman. The success of his effort in practically every case has been phenomenal in this particular, and the surface has only been scratched.

About the time that the association started this co-operative engineering movement, it also undertook the big task of eliminating fire and safety hazards. Again the "key men" were conscripted for this work. The value of this effort in actual dollars saved cannot be evaluated in any tangible manner. The effect, however, upon the morale of the different refining organizations is most remarkable, to say nothing of the wonderful change that has occurred in the physical condition of the plants who have undertaken the work.

The value of "human engineering" will save the industry incalulable profit, but before such attempt is made, let him who would undertake the experiment and profit thereby, first apply such psychology to himself in a spirit of toleration, lest he fail to accomplish his purpose.

Sweetwater Plant to Use Howard County Crude

Sweetwater, Texas. — Preliminary plans for the construction of a 5000 barrel daily capacity skimming plant near Sweetwater, with a 60-mile six-inch line connecting with the Chalk-Roberts field, located in Howard County, have been completed by Reese S. Allen, Wichita Falls refinery owner; Owen-Sloan Oil Company of Colorado, Texas, and the F-H-E Company of Sherman, Texas. The latter two concerns have considerable production shut-in for lack of a market in the Howard County area, and are drilling other tests to the shallow and deep horizons.

The volume of shut-in production in the Howard County area is in excess of 15,000 barrels daily from the 2500 and 2900-foot lime horizons, and there is no market available for the crude produced from these pay levels because of the presence of a high sulphur content. Most of the shallow production is being absorbed by the Colorado plant of the Col-Tex Refining Company, which is running about 8000 barrels of crude daily from Mitchell and Howard Counties.

General view of Simms Oil Company Smackover, Arkansas, refinery.

Getting 40 Per Cent Motor Fuel From Smackover Crude

By GEORGE REID
Associate Editor

CRACKING in both tube still and Cross unit operation, the Smackover refinery of Simms Oil Company is securing 40 per cent U. S. motor gasoline from heavy Smackover crude.

Latest engineering practices were employed in the construction of this plant. The assembly of equipment includes a tube still heated by a large and efficient carborundum or radiant heat furnace fired with gas. Bubble type fractionating columns are installed in conjunction with the tube still, and sufficient heat interchange equipment is employed to surpass somewhat the ordinary efficiency secured in most plants. The two Cross cracking units produce gasoline direct from the unit by means of bubble tower fractionating columns installed on each unit.

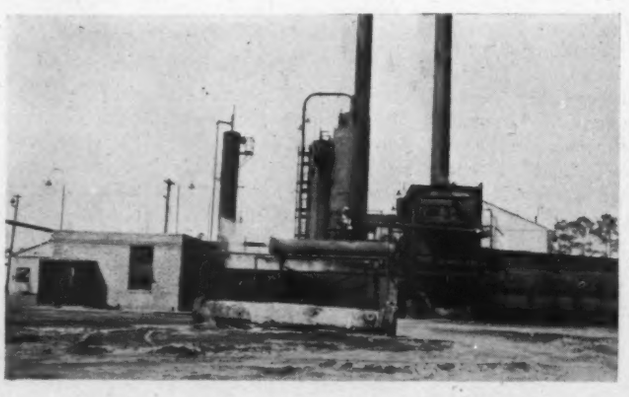
The plant is located on a large, rectangular site with sufficient slope to permit excellent drainage. The accompanying illustration or general view of the plant indicates the general scheme of layout and design which allows for future expansion of either cracking or skimming facilities. Tankage is grouped in parallel rows back of the processing equipment with the water tower and auxiliary handling equipment located adjacent to a large pond provided for water storage.

Soft water for cooling and steam generation is secured from two wells on the plant site which are 400 and 600 feet deep. The water supply is jetted from the wells by air pressure, and the wells are produced alternately to prevent sanding up and clean-up difficulties from either source. Terry steam turbines, 39 horsepower, driving Worthington, six-inch, 37-horsepower, centrifugal pumps, are employed for the circulation of water or the condenser boxes and through the cooling tower. The latter is not employed except in very warm weather.

This plant, like all of the Simms properties, is kept exceptionally clean. Paint is used freely for the dual purpose of rust prevention or "surface saving," and to lend a bright, clean appearance to the equipment. Simms color scheme of red, white and blue is carried out in the painting of tankage, office buildings and company homes for employees. Aluminum is employed in the painting of such equipment as the continuous and contact clay treating equipment. Buildings are all of structural steel framing and covered with corrugated iron, with flooring of concrete. The two central control houses are constructed of brick and cement.

Tubular Retort Operation

The operation of the tubular retort and bubble towers is of interest in that



Close up of tube still showing arrangement of carborundum radiant heat furnace. Note last exchanger placed above cooling coil box as described.

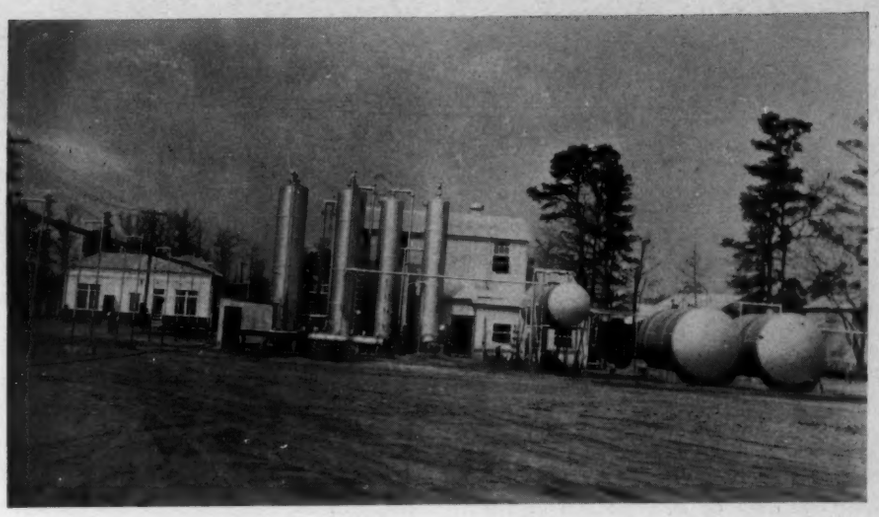
some novel practices are employed in effecting efficient heat exchange. Crude entering the system is discharged from a Worthington pump, size 14 by 5 by 12 inches, into a series of three Ross exchangers hook-up, so that the flow is continuous from one to another. These exchangers have recently been re-manifolded in such a manner that they may all be by-passed, if necessary, or any one or any two of them may be employed, with such changes being made instantly and without interfering with plant operation. It is often the case that exchangers, either single or in series, are not so manifolded that they may be by-passed or alternated in use, and the result is that in the event any exchanger becomes inoperative through plugging or corrosion of tubes, the refinery must be shut down while repairs are being made. A few simple fittings and by-pass lines installed at very little cost will rectify this condition and make possible the operation of the plant regardless of the condition of exchangers. The manifolding of the exchanger series at this plant was done more as a safety measure than of actual necessity, even though the crude charged is corrosive and contains the usual amount of water and salts occurring in Smackover crude. Superintendent R. E. Upp, in charge of the Smackover installation, and Fred N. Williams, manager of refineries for the Simms company, state that they deem it good practice to periodically inspect all of such equipment throughout the plant, and for this reason many of the plant departments are provided with such by-pass devices or stand-by auxiliary equipment, so that such inspection may be carried out wheenver it is thought necessary, without interfering with plant operation.

Gas Oil for Pre-Heating

Crude entering the first three exchangers is not pre-heated by residuum from the tube still operation as is the customary practice. Instead of residuum, this exchange of heat is derived from the counter-current flow of hot gas oil passing through the exchangers and coming from the bottom of the fractionating column. This gas oil stream, condensed and separated in the tower, is sufficiently hot to raise the crude oil temperature to 350 degrees F. Such exchange is considered fair in usual practice at many plants, but is not regarded as adequate pre-heat at the Simms plant.

From the first three exchangers, called gas-oil exchange, the oil is conducted to the smaller of the three towers, which is in this case a preliminary separating chamber. In this separator, at the pre-heat temperature of 350 degrees F., a small amount of light vapors are liberated, and all of the water present in the crude charged is distilled. The vapors are conducted from the top of the separator directly into the side of the bubble type fractionating column—which is the largest of the three towers.

Naturally, the crude loses some of its heat in this separation, but is is picked up by a second charging pump, also Worthington, and discharged into a fourth Ross exchanger. This exchanger is erected just above the water cooling coils where residuum is cooled. The exchange in this last pre-heater is with hot residuum from the tube still, which is conducted to the exchanger from the bottom of the large separator or vaporizer. In this step the incoming crude is pre-heated to a temperature of 450 degrees F. before it enters the retort.



Contact clay treating plant and continuous doctor treating system. Office shown in left back ground.

Details of exchanger installation-preheating crude by exchange with hot gas oil condensate. Supt. Upp at the left. Accumulator tank with liquid level controller, is all the receiving house present at this plant.

Tube Still

The gas-fired tube still consists of 270 tubes, four-inch O. D.—about 3¼ inches inside diameter. At the time of the writer's visit, the rate of charging was 3000 barrels daily. In passing through the tube banks, the oil is heated from 450 to 830-850 degrees F. Pressure on the still is maintained at about 150 pounds per square inch. This pressure is reduced to about 30 pounds as the oil enters the vaporizer or separator and without the disposition of coke. In the separator, all of the vaporized portion of the crude, down to a residuum having a gravity of about 7 to 9 degrees A. P. I., is taken overhead and into the bottom section of the fractionating column of bubble type. The residuum is conducted from the bottom of the tower to pass through the single Ross exchanger and effect a pre-heat of 450 degrees F. on the incoming charged crude. From the exchangers, the residuum is taken through the cooling coil in the box below the exchanger, and to storage.

All of the vapors entering the bubble tower are made into two cuts. Gas oil accumulates in the bottom section and is taken off through the exchangers to effect a 350 degree F. heat on the incoming crude. This gas oil is utilized as charging stock for the two Cross cracking units. The average gravity ranges from 20 to 23 degrees A. P. I.

This distillation and fractionation

unit as described is heated by an Alcorn carborundum radiant heat furnace, which received a great deal of attention and discussion at the recent convention at New York of the American Institute of Mining and Metallurgical Engineers. The furnace in question was discussed in a paper presented by H. S. Bell, titled, "The Modern Pipe Still," and published in The Refiner & Natural Gasoline Manufacturer, issue of March, 1928.

It will suffice at this time to state that at the time of the writer's visit the conditions were as follows: Charging 3000 barrels of heavy Smackover crude at 150 pounds pressure, with an outlet oil temperature of 830-850 degrees F.; a furnace temperature of 1350 degrees F., and a stack temperature of only 490 degrees F. Gas is consumed as fuel.

Overhead from the fractionating column is derived the naptha distillate, which is condensed and accumulated under the same pressure of around 30 pounds at which the bubble tower and separator handle the vapors. This stream is taken from the condenser coil to an accumulator tank. This accumulator tank is held at a predetermined liquid level as indicated by the gauge glass on the Fisher liquid level regulator. From the accumulator tank the naptha is blown to storage. Through this type of design the "receiving house" at the plant is reduced to one small tank just back of the stills, and requiring no attention.

When the plant is operating for the production of U. S. motor gasoline, the recovery of naphtha from the tube still is around 15 per cent of the crude charged. The stream of naphtha has a gravity of about 52 A. P. I. Combined with the production of gasoline directly off of the two Cross units, the gasoline yield for the plant is 40 per cent U. S. motor fuel.

Liquid ammonia is injected into the vapor line at the point where it enters the condenser coil. A small, electrically driven pump injects just enough ammonia to render the condensate slightly alkaline. This practice does much toward increasing the life of the coils. Other equipment has not been seriously affected by corrosion.

Treating Plant

Another interesting feature at the Simms plant is the contact clay treating plant, designed and installed by company engineers for treating the cracked gasoline to color and gum specifications. The first step in treating the gasoline consists of passing it through a continuous doctor treating system, prior to acid treatment. In the first of the treating columns the gasoline receives a contacting with spent doctor solution of around 17 gravity. This serves as a wash to remove any hydrogen sulfide present which will occur in the gasoline from the cracking units. After this wash the gasoline is conducted through a series of two horizontal mixing devices. The horizontal cylinders are perhaps 15 inches in diameter. Inside of the cylinders there is a revolving paddle arrangement which is mechanically rotated by means of chain drive and a small electric motor. When the gasoline and doctor solution (19 to 22 gravity) enter these mixers, a very intimate contact is secured. It is necessary to add but about one pound of sulphur per 100 barrels of gasoline to obtain a completion of the reaction. The spent doctor is settled off in a second settling drum, and the gasoline is conducted to the nearby tanks. From these tanks the doctor sweet gasoline is taken to settling storage or working tanks.

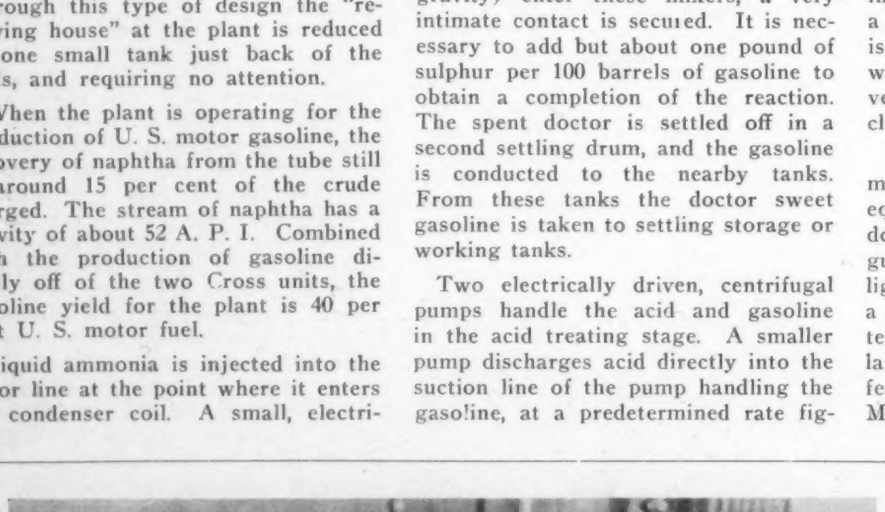
Two electrically driven, centrifugal pumps handle the acid and gasoline in the acid treating stage. A smaller pump discharges acid directly into the suction line of the pump handling the gasoline, at a predetermined rate figured in pounds acid per barrel of gasoline. The gasoline pump discharges the intimately mixed gasoline and acid through a 1½-inch line directly to two De Laval centrifuge machines.

The centrifuges operate by belt drive from an electrically driven shaft and at a rate of 5500 to 6000 revolutions per minute. The spent acid is removed through one outlet and conducted away. The gasoline flows by gravity through a six-inch line directly into a vertical tank where it is mixed with the clay. The centrifuges handle the acid-oil mixture at a rate of 40 barrels per hour, each, giving the treating plant capacity of 80 barrels hourly.

Both treated gasoline and clay are introduced into the top of the large upright tank used for this purpose. The tank is equipped with a series of paddles extending from a central shaft which is rotated by chain drive from an electric motor. As the clay and gasoilne descend into the lower section of the mixer and accumulate at the bottom a duplex steam pump takes suction and removes the mixtures at a predetermined rate discharging it to one of two Sweetland filter presses.

The presses are used alternately, one being dumped while the other is charging. The spent clay is deposited into a large hopper or tank, from where it is washed through a large drain line with water. The presses require but very little time and labor to pump, clean, and have ready for use again.

The finished gasoline treated in this manner tests about 45 per cent benzol equivalent in anti-knock value. It is doctor sweet, non-corrosive, and no gums, and its color is stable in sun light. The treating plant is practically a duplicate of the Simms treating system at the Simms Oil Company's Dallas, Texas, plant and it is one of the few contact clay treating plants in the Mid-Continent field.



De Laval centrifuge machines for separating sulphuric acid from treated gasoline. Six-inch line on the floor conducts the acid free gasoline to contact tank, using Riverside clay.

Essential Treating Details for the Hypochlorite Method

By W. R. HOUNSELL
Superintendent Houston Oil Company

HYPOCHLORITES are salts of hypochlorous acid. This acid is so unstable it cannot be used for the manufacture of these salts, by neutralizing such bases as caustic soda or lime. When chlorine is introduced into pure water, hypochlorous and hydrochloric acids are produced, but, in a very short time these acids react with one another to produce chlorine and water again. Disregarding the electrolytic process, the best method for making sodium or calcium hypochlorite, would appear to be the introduction of chlorine gas into a solution of caustic soda, or an agitated suspension of lime in water.

This procedure is not as simple as it reads, and yet there need be no trouble experienced by the careful operator, who does not depend on rule-of-thumb proportions. Needless to say, the large majority of refiners who have tried hypochlorite treating have become disheartened either because they could not make a satisfactory treating solution, or because their final product reverted in color during storage. There is little wonder in this, as during the formation of the hypochlorite, considerable energy, in the form of heat, is liberated. Then, also, concentrated solutions of a hypochlorite are very unstable; temperature must be kept down and excess of chlorine must never occur.

In making solutions suitable for treating straight-run benzine and gasoline distillates, certain precautions are necessary, to avoid the pitfalls that have discouraged the pioneers. The controlling factors of safety, during preparation of stock solutions are: (1) Careful and constant flow of chlorine. (2) Cooling the agitating mixture. (3) Chemical control of alkalinity and normality of the batch until completed. If lime is used as the alkaline base, the resulting solution will contain calcium hypochlorite, calcium chloride and various impurities, but the normality test will be relative only to the available chlorine present in the hypochlorite radical.

The well known desulphurizing effect of hypochlorite, when agitated with petroleum products, is due to oxidation and liberation of considerable chemical energy during the reaction. Chlorination of the saturated organic compounds is negligible when the treatment is conducted correctly, but additional compounds are formed with certain unsaturated hydrocarbons, even in presence of alkaline solutions. This means that cracked products and distillates containing much unsaturation should not be treated with hypochlorite solutions. There is, however, a sufficient quantity of natural and straight-run gasoline alone, being manufactured, to merit further investigation into this very interesting method of treatment.

Manufacture of Hypochlorites

Sodium hypochlorite has been used extensively in the treatment of light petroleum products, but after considerable experimental work had been done with calcium hypochlorite, it was found that the latter was quite as efficient under the right conditions.

Calcium hypochlorite requires careful attention throughout each stage of operation, and as lime is cheaper than caustic-soda, this solution has practically replaced the former.

In the manufacture of sodium hypochlorite the absorbing vats are arranged in line, and occupy the top floor of a three-story building, having a well ventilated roof. The caustic soda is dissolved in the usual way with steam in the soda tanks, is run to the usual blow-cases and transferred by air pressure to the absorbers.

Three thousand gallons of 13 degree Baume caustic soda are charged to each vat, and cooled by using water coils inside the vats. Before chlorinating, the vat temperature must be below 95 degrees F., then the solution is tested for alkalinity, and 13 degree Baume will equal approximately an alkalinity of 80 (see laboratory tests). Chlorine gas is now bubbled through a quarter-inch perforated cross on the bottom of each vat, while the bath is kept in circulation by means of a pump and the temperature kept down by circulating cold water through the closed coils. At atmospheric temperature the average pressure in the chlorine containers would be about 50 pounds, and at this pressure the quarter-inch block valves to the absorbers may be opened fully. The alkalinity of the bath now decreases and must be tested periodically.

Toward the end of the chlorination, which should take three hours by careful regulation, the chlorine is shut off during the testing of the solution. The bath is finished when the alkalinity is between 0.6 and 0.8, and the normality (see laboratory tests) is between 2.0 and 2.4 normal. It is well here to again emphasize the fact that the bath should be watched closely toward the end and chlorine shut off while making tests.

If a bath becomes over-chlorinated, the solution loses its alkalinity, rapidly decomposes, and loses practically all of its available chlorine. Then this solution is useless, containing nothing but sodium chloride and chlorate, and the chlorine escaping into the air is a menace.

Twenty-three hundred pounds of chlorine, 2800 pounds caustic soda, 3000 gallons of water, make 3000 gallons plus of 2.ON Sodium Hypo.

As 2.O/N. Hypo. is much too strong for practical use in the agitators, it should be diluted before use, to about 0.34/N, either by adding the strong liquor to water already in the agitator, or by previous dilution in the charging tank. Then the above batch using 2300 pounds of chlorine will make 18,000 gallons of treating hypo. of 0.34/N strength.

Calcium Hypochlorite

Quick-lime of good grade is slaked with water, to a thin cream, in the slaking mills in the usual manner. Twenty-six hundred pounds of lime is slaked for every absorber requiring it; the mixture is then run through fine screens and pumped to the absorbers.

Chlorination takes place in the same way as in the case of sodium-hypochlorite.

Gravity before chlorination, 7 to 9 degrees Baume.

Gravity after chlorination, 13 to 14 degrees Baume.

Normality after chlorination, 2.0.N.

The hypochlorite in the absorber will change in color quite noticeably, toward the end of chlorination, taking on a darker appearance. Hypochlorite of 7 degrees Baume at the start, runs to 2.0.N. before changing color. Hypochlorite of 8 degrees Baume at the start, runs to 1.9.N. before changing color.

Twenty-six hundred pounds of lime, 2300 pounds chlorine, 3000 gallons water, make 3000 plus gallons of 2.0.N. Calcium Hypo.

After chlorinating, the vat is allowed to settle, and the clear liquor syphoned off to storage. From storage, the solution is taken, as required, and diluted, either in the agitator itself, or in a mixing vat. After the clear liquor has been syphoned off, about 400 gallons of lime sludge is left in the vat, and this is dropped to the sludge-pots below. These pots are similar in dimension to the absorbers, and are equipped with mechanical agitators but not with chlorine-pipes. The sludge is accumulated until the sludge-pots are nearly full, and as a certain amount of hypochlorite is unavoidably dropped into these pots, a period of 24 hours is allowed for settling, and the clear liquor syphoned off to the storage as before. The remaining lime-sludge is washed out with water and run to the sewer. Well made clear hypochlorite will keep for a long time, in storage without losing any appreciable amount of oxygen or available chlorine.

Before going further, it will be well to

point out that although the most efficient strength at which to make the hypochlorite is a twice normal solution, yet this is always diluted to 0.34.N. strength before use in the benzine and gasoline agitators. The reason for this is that it was found by experiment, that a solution of half-normal (0.5.N.) hypochlorite, when used in treating benzine (having a kerosene base), chlorinated the oil. The chlorine combined with certain hydrocarbons, forming substitution products which, upon further distillation, formed corrosive acids and darkened the color of the kerosene bottoms.

Bleaching Powder

In cases of emergency, bleaching powder has been used in treating light distillates, but is not very satisfactory, as the normality of the solution must be very high (about 1.8.N.) before any satisfactory results are obtained.

Twenty-three hundred pounds of the powder are dissolved in 1600 gallons of water, making the solution approximately 1.4.N. By adding 220 pounds of chlorine this normality becomes about 1.8.N. This solution is then used on the agitators in the same manner as calcium hypochlorite. Bleaching powder solutions seem invariably to cause emulsions, that are very hard to break. An ordinary calcium hypochlorite emulsion will usually break quickly on the addition of two or three bucketfuls of 5 per cent sulphuric acid to the agitator, containing 11,000 gallons of oil.

Electrolytic Hypochlorite

Electrolytic sodium hypochlorite is a very pure product, and consequently is always dependable. Unfortunately, however, this excellent material cannot be used on a large scale at present, as the price of its production is prohibitive.

Long vats are used in this process, containing a large number of carbon electrodes. These electrodes are in slab form, and stand vertical in the baths, separated by rubber gaskets to form cells. The electrolyte solution of common salt runs in at one end of the first vat and the finished hypochlorite flows from the opposite end of the last.

Two thousand four hundred sixty pounds of common salt in 1800 gallons of water are circulated through the porous electrodes, carrying a direct current charge of 125 volts at 230 amperes. The sodium hypochlorite is considered finished at 0.3.N. and is used straight for treating.

$$NaCl + H_2O = NaOCl + H_2.$$

Hypochlorite Treating Benzine

The following treatments are used on benzine from high-sulphur crudes, and on intermittent treating. When "Recovered Soda" is mentioned, this means caustic soda that has been recovered or reclaimed from previous treatments by concentration in small stills. This recovered soda, therefore, contains varying percentages of impurities, such as stable and unstable sulphur compounds, and consequently must be used with discretion.

The benzine in the agitator is given a 3 per cent treat with 10 degrees Baume recovered soda, agitated by circulation through a centrifugal pump for 30 minutes, allowed to settle and the spent soda drawn off. The oil is then given a 20 per cent wash with water, settled, and the water drawn off.

Then comes the 16 per cent hypo. treatment, agitation for two and one-half hours, the settling and drawing off.

Finally the batch is given a three per cent treat with 10-foot Be fresh caustic soda and settled. This soda is not washed out wtih water, but the oil goes to the continuous benzine stills while still holding some of the solution in suspension. The final permanganate test (see laboratory test) after treating, should be about 30 seconds.

After this treatment, the residual normality of the spent hypo. should be zero, and, if much sulphur is present in the untreated oil, it usually requires two such treatments with hypo. in succession, before the final soda wash. In this case, the normality of the first waste hypo. should be zero, and the hypo. drawn from the second treatment should be near to 0.09 N.

For the sake of economy, the used hypo. solution from the second treatment, should be made up to strength by addition of strong hypo. from storage, and then may be used for the first treatment of 20 per cent. The word "Hypo," is used here as an abbreviation for calcium hypochlorite.

Hypo. Treating Gasoline

Gasoline usually requires only one hypo. treat, provided the benzine has been previously hypo. treated, but if the benzine has only received a caustic soda treatment and a water wash, then two hypo. treatments are given to the gasoline.

Gasoline for one treat receives a 13½ per cent treat with 0.34.N. Hypo.

Gasoline for two treats receives a 16 per cent and a 9 per cent treat with 0.34.N. Hypo.

The gasoline receives first the hypo. treatment or treatments as explained above. The latter hypo. treat is continued until the normality of the hypo is very low (say 0.05.N.); but, in any case, at this stage, the gasoline must pass a 5 minute permanganate test. Next comes a 3 per cent treatment with 13 degree Be. caustic soda for 30 minutes, and finally, two 20 per cent water washes lasting 10 minutes each.

In any treatment where calcium hypo. is the reagent in the agitator, it accasionally happens that a little "medicine" is necessary to bring the reaction to completion.

Suppose, for example, the usual amount and strength of hypo. is pumped into the gasoline (0.34.N. Hypo.) and agitated two or three hours, with the normality refusing to go below 0.2.N. This condition can be remedied and the reaction corrected, by adding from 14 to 25 pounds of sodium bicarbonate, which liberates the nascent oxygen and combines with the chlorine. Ferrous sulphate, dissolved in hot water, has the same apparent effect and is used in some instances, it requiring 15 to 25 pounds dissolved in a bucket of water, which is poured slowly into the oil.

When not handled too violently, two or three buckets to a 11,000 gallons charge, of a 5 per cent solution of sulphuric acid, will break up hypochlorite emulsions.

Continuous Treating Plant for Hypo. Treating Benzine

As drawings are not available, a brief description of operation must suffice, at this time.

The untreated benzine enters the suction of a centrifugal pump on agitator No. 1, mixes with the soda already in the cone of the agitator, by the impellers of the pump, is pumped over the top of the agitator, down through a pipe 8 foot, 6 inch long, and strikes the baffle plate attached to the end of the pipe. Further mixing takes place here to a certain degree but the majority is accomplished in the pump.

The overflow of benzine from the top of the spirit level in agitator No. 1 enters the suction of agitator No. 2 pump, mixes with water from the cone of the agitator and is thrown over the top into agitator No. 2.

In agitator No. 3, the washing is just a repetition of the wash in agitator No. 2.

The calcium hypochlorite solution enters the benzine in agitator No. 5, from a measuring box containing a "V" notch device, and gravitates to the cone. It then mixes with the overflow from agitator No. 4 in pump No. 5, and is taken back over the top of the agitator No. 5. A little of this mixture is allowed to flow into the top of the agitator No. 4, to keep it supplied with a weak solution of hypo., and this mixture that flows back is reinforced if necessary, with strong hypo. from storage. This reinforcing is only necessary when the normality of the hypo. in cone No. 4 gets too low.

Pump No. 4 delivers a mixture of weak hypo. and benzine, over the top of agitator No. 4, and enough of this is allowed to flow into a small separator; then the hypo. from this runs down underneath to a waste box.

The overflow from agitator No. 5 runs to pump No. 6 and receives a final soda wash, is pumped back over the top of agitator No. 6 and then overflows to the finished-benzine tanks.

These operations are run in countercurrent treatment, the oil running through the system in the opposite direction from the flow of chemicals. Thus the raw benzine meets the weak solutions and leaves the system under the influence of fresh solutions.

When more than one agitator is used on one chemical or water wash, then the wash solution enters the last agitator and travels the reverse direction from that in which the benzine is travelling. This is done by manipulation of valves, by-passing and so on, and these valves are constantly being regulated to control operation.

Example—The benzine is coming into pump No. 1 at the rate of 200 gallons a minute, and it must flow over into the other agitators, and finally overflow to storage tanks at that rate. The pumps

(Continued on page 106)

Relation of Natural Gasoline to Refineries

By BERNARD O'CONNOR*
Refinery Manager, California Petroleum Corporation

THE paper here reproduced is but part of what Mr. O'Connor presented before the California Natural Gasoline Association. Before getting into the subject of the relation of natural gasoline to modern refinery practice, he dealt with refining methods.

The first part of his paper, that dealing with refining methods, has been eliminated in order to present the vital part of the subject in a minimum of space.

OF just how much use is natural gasoline to the refinery operator or manager and what does it accomplish? Can he get along without? Does it raise the cost of the marketable products? Does it offset this raise in the price of the finished product by increasing the yield of naphtha from a given crude? If the yield of a certain product is increased by using natural gasoline how is this accomplished? Does natural gasoline increase the quality of a gasoline when blended into the product? Will so-called "cracked gasoline" eliminate the use of natural gasoline for blending purposes? What are the objectionable points of the refinery man as to use of natural gasoline and how can they be made satisfactory to the refinery? These are only a few of the many questions, the refinery man meets in conjunction with using natural gasoline and with your permission we will try to give you our opinions on each.

Of just how much use is natural gasoline to the refinery operator and what does it accomplish for him?

Natural gasoline is of major importance on Pacific Coast gasolines, at the present time, particularly to refineries confining themselves to straight run operation. Most of the California crudes produce a naphtha which will give the desired 50-90 per cent and end point, but will lack the essential light ends of a good motor fuel. These light ends can be supplied by the blending with natural gasoline so a marketable gasoline can be obtained which will give low initial and front end for ease in starting and acceleration and enough heavy ends to give mileage and power. The point at which mileage and power can be obtained without sacrificing other desired properties of a gasoline is a question of opinion, some technicians maintaining that heavy ends can be utilized by proper compensation of light ends, others maintain that heavy ends can not be compensated by light ends except to a very limited extent. Others take a happy medium. Arguments for each can be made and are logical, it again depending on the company's policy, position, etc.

Another of the most important uses of natural gasoline is the increasing of the Benzol value of the motor fuel which affects the detonating quality of the product. This feature is very important from the refiner's standpoint especially in these days of high compression motors. Natural gasoline also raises the gravity of a motor fuel, how much depending on the amount used. This has no effect on the quality, but does have considerable effect on the marketability of the product insofar as the public is concerned, and also affects the sales department of any company. The public, not knowing what determines the quality of a gasoline, is still to a more or less extent, demanding gravity as the sole measure of quality, while quility is not *solely* dependent on gravity, this item being merely one rough method of measuring the volatility.

*Before California Natural Gasoline Association, March 14, 1928.

What It Accomplished

Therefore it may be said that the use of natural gasoline accomplished the following for the refiner:

1. It raises the gravity so the public is satisfied and allows meeting of sales competition from standpoint of gravity.
2. Furnishes ease in starting and accelerating properties by making easily obtainable the desired initial boiling point and the desired front end of the gasoline.
3. It aids the question of detonation by proper use in the finished gasoline.
4. It will increase yields of naphtha from certain crudes by proper handling, this point to be discussed later in the paper.

This covers the principal advantages of the use of this product.

Can a refiner get along without natural gasoline?

Yes, he can, if necessary, although, not having it available, would be of considerable disadvantage to the refiner.

If his crude is such that he can obtain a naphtha having a desirable light end and desirable heavy end, he can eliminate the necessity of blending. For example, certain crudes like Ventura Avenue, Santa Fe Springs, Pico, and a few others, give a desirable boiling point—range naphtha and do not actually require a blend although a blend can be made if desired, as, though naphtha producable from such crude may give a good range of boiling points, a slightly better range might be obtainable by using some natural gasoline.

If he has available sufficient production of so-called pressure or cracked gasoline to obtain the desired volatility, he can eliminate use of natural gasoline. This will be covered in detail later.

If the company does not object to marketing an inferior product from a volatility standpoint it can eliminate use of natural gasoline, or if the public did not demand such a good grade motor fuel on this coast, the use of natural gasoline could be eliminated. A fuel on this Coast might be considered of poor volatility compared to other competitive fuels, but in the East or Great Lake District, be considered very desirable.

Therefore, I believe it safe to say that natural gasoline can be eliminated under certain conditions, but is not desirable to do so if avoidable.

Cost

Does blending raise the cost of a marketable product gasoline?

This depends upon the price of the natural gasoline blended, of course. Usually the price is considerably above the cost of treated naphtha from crude by refinery operation. Therefore, the marketable gasoline is higher in cost to the refinery if a blend is used.

Does it offset this increase in cost price in any way, and if so, how?

Yes, natural gasoline does compensate for this increased cost price as follows:

1. It meets desired specifications for the refiner which makes the product marketable.
2. It furnishes ease of starting and acceleration properties necessary for a good motor fuel.
3. It will on all crudes allow a slightly increased yield of naphtha by allowing the refiner to go slightly beyond his specifications and bring the finished blended stock back to the desired specification by blending with casinghead.
4. On certain crudes like the Midway crude in the San Joaquin Valley, allow a tremendous increase in naphtha due to the characteristics of this crude. This crude is of such nature, or at least the crudes from this section with which I have had experience, are of such a nature that it is possible to utilize practically all of the normal kerosene distillate cut into the gasoline and still produce a desirable gasoline by the proper utilizing of the casinghead. Some refiners believe in blending the casing head with the crude before distillation, others blending with the naphtha after distillation and treatment. It is merely a question of financial balance, which is best suited for the particular company concerned and the crudes involved.

Hence it can be said, without any fear of contradiction, I believe, that the increase in cost due to blending with natural

gasoline is jutifiable because of certain desirable effects on the gasoline, both in quality and yield of the marketable gasoline.

Influence of Cracking

Will so-called "cracked gasoline" eliminate the use of natural gasoline for blending purposes?

In our opinion the answer to this question is "no," although it will have some effect on the natural gasoline situation.

Cracked gasoline does have a low initial and a low 20 per cent boiling point, approximately comparable to a natural gasoline distillation range. But at the 50-90 and end point, the cracked gasoline will more closely approach the boiling range of the straight run naphtha. Cracked gasoline will also be considerably lower than natural gasoline in gravity although considerably lighter than straight run naphtha.

Therefore, a blend made from straight run naphtha and cracked gasoline will vary from one made with straight run naphtha and casinghead as follows, the same percentages being used in each case:

(a) Gravity will be lower on the "cracked gasoline" blend.

(b) The initial boiling point of a cracked gasoline blend may be the same but other boiling points up to 50 per cent will be considerably higher.

(c) That it will not allow increased yields of naphtha on certain crudes.

Therefore our opinion is that cracked gasoline will not replace or eliminate the use of natural gasoline. We do believe, however, it will control the price of this product within certain limits. When natural gasoline reaches a price that it can be replaced by cracked gasoline allowing for the monetary value of certain advantages due to blending with natural gasoline then the refinery will utilize cracked gasoline for blending stock. This, of course, depends upon the refiner's position in regard to available cracking apparatus, the competitive gasolines against which he must market and other items which necessarily must pertain to each individual company's problem. It all must work back primarily to the financial analysis of the entire question. As you all know, this oil business must be reduced to the almighty dollar, the question resolving itself into what is the most profitable operation for the oil company, not considering the gasoline department as a unit, or the refinery as a unit, but considering the entire company as a unit.

There are, of course, disadvantages to the refinery department in handling natural gasoline, such as storage losses, receiving losses either by pipe line or tank car, the limitation of how much natural gasoline can be blended into a given naphtha without getting too much for best results, the hazard of handling and others. You will realize, of course, that the more of these disadvantages to the refiner that can be eliminated, the more desirable from the refiner's standpoint. This, however, can be carried to an extreme and a natural gasoline produced which will satisfy the refiner in all respects and yet work an unwarranted hardship on the natural gasoline department of a company. There is a happy middle course to be followed which means the most money for the company as a whole. This middle course may have certain objectionable features from a refiner's standpoint, from the gasoline company's standpoint and indirectly, from the sales organizaiton standpoint, but when considered from a view of the entire company is desirable. This is the desirable course to follow, naturally.

The disadvantages pointed out, namely storage losses, receiving and handling losses, etc., can be to some extent partially corrected by proper refinery operation and design, but not entirely, as the kind of natural gasoline produced is also of much importance. It is, of course, but common sense that the more stable the casinghead or natural gasoline received by the refinery, the less the loss, and therefore, better for the refiner.

The amount of natural gasoline that can be blended into a motor fuel is almost entirely dependent upon the kind of natural gasoline used for blending. If it is wild you can put in so much, any excess of wihch will cause gas lock on a motor. If the blend stock is stable, more can be worked into the motor fuel with desirable results and have no trouble with "gas locking." This is an advantage to the natural gasoline department, in a poor natural gasoline market especially, as it means this product can be worked out into the motor gasoline at an advantageous price perhaps rather than being disposed of as "distress gasoline." It also allows the refiner to work up any excess natural gasoline he has on hand and eliminate the tremendous losses which must take place if any large amount of this volatile product is stored and also eliminates the additional fire hazard to the refinery as well.

The refiners naturally in considering the question will look out for the interests of the refinery department. Likewise the gasoline department head. This, we believe, is wrong and is gradually correcting itself, but only slowly. In order to get the ultimate desired results in the shortest time possible in the matter it is going to mean that the gasoline company or department and the refinery department are necessarily going to have to forget their departmental profits and consider the matter entirely from what is best for the entire company. Instead of one department taking advantage of the other, and one showing an unwarranted profit indirectly at the expense of the other, both have to get together.

In addition, they must take into consideration the problems of marketing encountered by the sales department and give such problems worthy consideration. After the entire matter is thoroughly balanced and analyzed, the auditing department must admit the financial analysis of the matter and the most profitable course followed, regardless of what department is affected. Then by all the departments getting behind the matter, cooperating and pulling together, the best results will be obtained at a minimum cost. I am glad to state here that in our company we have already adopted this method of cooperating and I believe Mr. Hare, Mr. Starr and Mr. Parmelee will verify my statement that this cooperation has meant many dollars to our company. We have already started the cooperation with the sales department mentioned and are beginning to get results far beyond our expectations. We find it most decidedly worth-while.

It is going to mean that you of the natural gasoline side of the oil industry will face rigid specifications and must adhere to them or suffer the rightful penalty. It will mean that your departmental profit will shrink perhaps in some cases. It will mean that you will be more or less handicapped by necessarily having to consider the refinery department needs, the effect of certain steps on sales or marketing organization problems. But it will mean more money for the oil companies as a whole, which is of course what is most desirable and what we are all trying to accomplish. So, don't think that the refiners are unreasonable to insist on certain specifications, for they are necessarily bound by sales specifications and can not do otherwise. It is merely a question of cooperation to the fullest extent and I am sure that in the end, all will benefit by such a procedure.

Natural Gasoline Meeting Program Arranged

Tulsa.—Although not yet complete, the program for the seventh annual convention of the Natural Gasoline Association has been announced. The convention is to be held in the Mayo Hotel, Tulsa, May 22, 23 and 24.

It has been decided to crowd the program into two days of the meeting. This will leave the third day for a field trip to the Seminole area, which has been the scene of the greatest expansion of natural gasoline plants in the past year. In order to complete the program in two days, one night session will be held. This session will be the evening of May 22. The next evening will be given over to the annual banquet.

The program has not yet been divided as to time. The subjects and speakers follow:

Paper, "Theory and Practice in Rectification in Natural Gasoline Plants," L. S. Gregory.

Paper, "Volatility of Natural Gasoline," G. G. Oberfell, Director of Research, Phillips Petroleum Company.

Paper, "Gas Lift and Its Relation to the Natural Gasoline Industry," H. B. Bernard, vice president, Sinclair Oil & Gas Company.

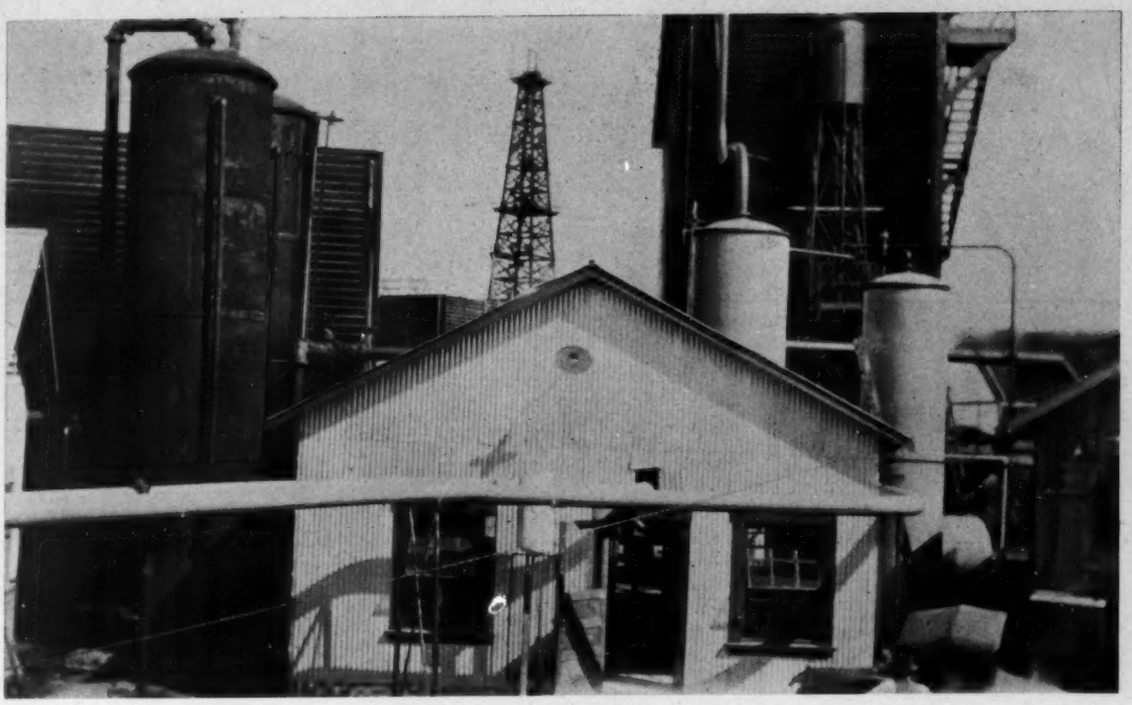
Paper, "Second Progress Report of the Natural Gasoline Association of America," Dr. G. G. Brown.

Paper, "Importance of Gas and Gasoline Analysis to the Natural Gasoline Industry," to be read from someone from California.

Paper, "Theory and Practice of Automatic Control," T. G. Laney, Fisher Governor Company.

Paper, "Methods in Marketing," W. T. Anderson associate editor, the Oil & Gas Journal.

Paper—"Some Conditions Affecting the Butane Industry"—S. C. Carney, Roxana Petroleum Corporation.



General view of new unit, showing part of several installations

Long Beach Gasoline Plant Is Up-to-Date

By BRAD MILLS

THE recent completion of a 20,000-gallon unit gives the Lomita Gasoline Company one of the most up-to-date absorption plants in the Long Beach field. The new unit embodies the latest approved ideas and brings the capacity of the entire plant to 42,000 gallons daily.

The Lomita Gasoline Company was originally incorporated to handle gas from a lease owned by the City of Long Beach. It has grown until it is now handling gas from more than 60 wells. The new unit was the natural result of this expansion. The first units were built in 1923 and are now producing about 22,000 gallons daily.

By following the gas through the new unit, it is readily apparent that only the latest type of equipment has been installed. It is a remarkably compact arangement, occupying a much smaller space than many old-fashioned units.

The compressors pick up the gas from the various Signal Hill wells and discharge it through the gas cooling coils located in the tower. The distillate precipitated in this cooling is collected into accumulator scrubbers and discharged to automatic float control to slop tank. This distillate contains a considerable amount of foreign matter, which would contaminate the oil in the system and would impair the efficiency of the heat exchange apparatus. It is run through a separate steam still, the vapor from which connects with the vapor line from the main plant.

After leaving the accumulator scrubber, the gas passes into a wash scrubber, where it is washed by gasoline circulated through the scrubber by means of a small pump.

This method of treatment sends the gas to the absorbers free from crude mist and finely divided foreign matter which the raw gas carries in suspension, and keeps the oil in the plant in perfect condition.

The distillate from this scrubber is changed periodically and run through the small still mentioned above for the extraction of its gasoline content.

The gas, after leaving the wash scrubber, is distributed to the base of the Oil Froth absorbers, and after giving up its gasoline content to the oil, passes out to the fuel lines supplying Long Beach .

The fat oil leaving the base of the absorber is controlled by heavy floats located in the bottom section of the absorber and is admitted to the suction of the fat oil pump, which discharges through the heat exchangers, the preheaters and into the strippers. The hot, lean oil leaving the strippers passes through the heat exchangers to the suction of the lean oil pumps, and is discharged through the cooling coils and back to the absorbers.

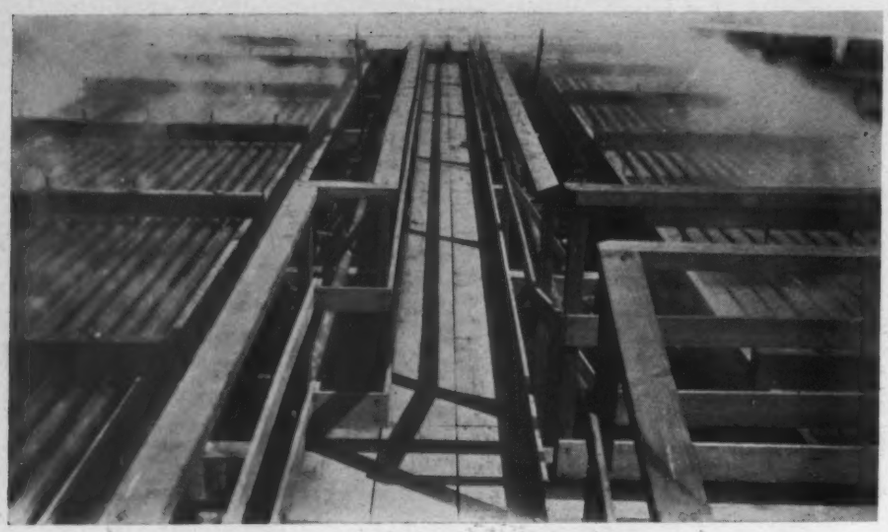
The vapor leaving the top of the stripper goes to the dephlegmator, which is isolated on the top of the cooling tower, and consists of 20 passes of two-inch pipe in a shallow wooden box, in which the pipe passes down one side of the cooling tower, across the end and back down the other side. The coils discharge through a header into a mist extractor, which separates the reflux from the gasoline vapors. The latter pass through a short fractionating column, being admitted through the bottom and passing out the top.

The reflux, after dropping down to an automatic dewatering tank, where it is separated from the condensed agitation steam, rises by static head, flows over the top of this column, washing the gasoline vapors, and is admitted back into the top of the vertical stripper.

This system of dephlegmation, which is used in all Campbell-constructed plants, is automatic and gives perfect control of the product. Its big advantage lies in the fact that all the heat given up is dissipated into the atmosphere by the evaporation of water from the box. The amount of cold water fed to this box is controlled thermostatically by a bulb located in the mist extractor.

The Stripper

The stripper used in the new unit is a decided departure from former practice



Above—Novel installation, showing levers for adjusting sprays on top of cooling towers.

and gives remarkable results in stripping the oil. There are eight sections in this stripper, and the design is such that the agitation steam, after frothing the oil in each section, atomizes it into an atmospere of steam and vapor, so that the opportunity afforded the lighter fractions for freeing themselves is remarkable.

The gasoline, after leaving the condenser coils, goes to the vapor transformer, where it is selectively fractionated so that the finished product has a recovery of 92 per cent. This apparatus is also thermostatically controlled.

The pumping is done with reciprocating steam pumps exhausting directly into the agitation header for the stripper. All exhaust steam is used in this manner and the dephlegmating system is so flexible that perfect control is obtained under all conditions.

The cooling tower is 42 feet high. A total of 32 small sprays located in adjustable spray headers break the water up very finely and give perfect distribution over the coils. The coil arrangement is such that cold water falls on every pipe, and all warm pipes are located on one side of the tower to afford the best conditions for cooling. The day the writer visited the plant, the oil was going to the cooling towers at 62 degrees, the circulation of the oil being 280 gallons per minute.

Automatic Control

The new unit is automatically controlled throughout. By watching the various instruments, the operator is able to run the plant with a minimum effort.

The average gravity of the gasoline coming from the plant is about 90.5 degrees, showing remarkably efficient extraction. The average gravity of the finished product, after being stabilized, is about 87 degrees.

The simplicity and efficiency of the unit would appeal to the average company. The Lomita plant is particularly suited for handling the rich gas from the deep sand. The gasoline content runs as high as four gallons per thousand cubic feet.

The cooling tower is equipped with adjustable sprays, which may be turned into the wind to maintain the maximum cooling effect. Two lengths of two and one-half-inch pipe are run across the top of the tower. Unions have been installed at both ends of the pipe. By simply working levers, the sprays are adjusted to the desired levers. The rows of two-inch coils are carefully staggered so that each receives its full share of spray.

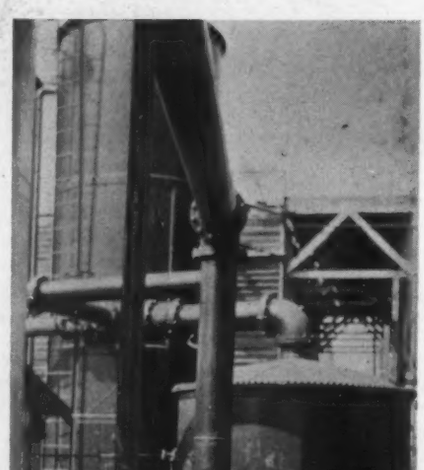
A battery of nine, 165 horsepower Clark compressors is used to pick up the gas from the field. The gas is discharged through the cooling coils at 35 pounds pressure.

Tulsa—The constitution and by-laws of the Natural Gasoline Supply Men's Association is now ready for the consideration of members of the organization and prospective members.

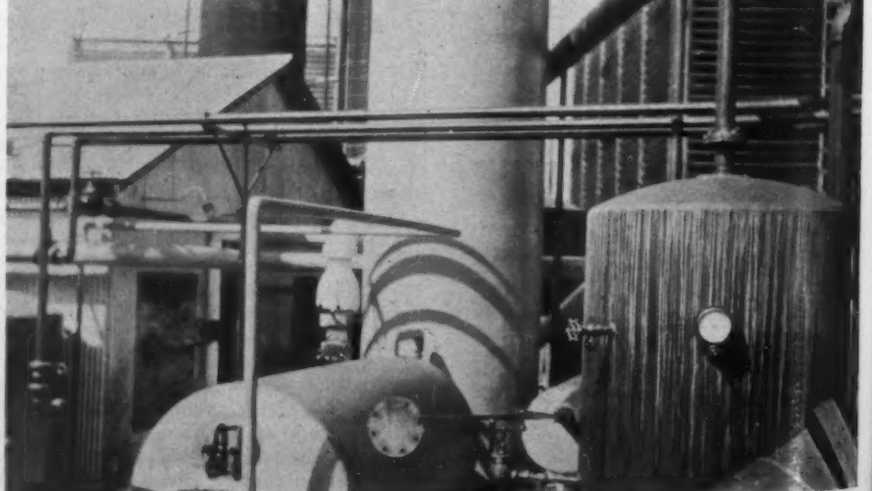
This organization was formed last year for the purpose of providing entertainment for the annual convention of the Natural Gasoline Association of America. Following the convention it was decided to try to form a permanent organization, whose purpose will be to provide this entertainment each year.

It is the purpose now to have the constitution and by-laws approved and the permanent organization perfected before the coming convention of the Natural Gasoline Association here May 22, 23 and 24.

The constitution and by-laws have been approved by directors of the Natural Gasoline Association of America.



At Left—Wash scrubber and absorber. Below—Dewatering tank, surge tank and stripper.



Clays—and Their Application in Refining

By GEO. W. CUPIT, JR.
Chemical and Refining Engineer

WITHOUT doubt, one of the most important and practical recent developments in petroleum refining has been the preparation of clay for various uses in decolorizing. So important has this phase become, that in many instances, large savings have been made possible by their use in cutting down the amounts of certain chemicals used in processing, and in several instances, entirely eliminating the use of other chemicals. This is by no means the only advantage the use of clays has brought to light. It has been proved conclusively that as far as plant production of finished products is concerned, the degree of production has been increased 100 per cent and in many cases even higher. This fact alone would cause even the beginner in petroleum refining to take notice. It may here be well mentioned, that we have not only entered upon an interesting, but likewise a difficult subject. In the application of clays to oils, and vice versa, it is possible to answer correctly numerous questions which have automatically arisen from time to time. However, there remain many questions which are still unanswered and upon which a great deal of time and concentration (to say nothing of money) are now being wisely spent.

One of the vital factors in the application of clay to oil is the proper selection of the clay. A second important factor deals with its preparation. It is only in very recent years that the application of fine (powdered) clay to oils for decoloration, and likewise neutralization of acid treated oils, has been of commercial value. In reference to the fine clay, I mean the finest part of the clay (after grinding) which was at one time found useless commercially, but which is now being used with marked success in contact work.

The clay, which is used for the most part today, is generally known as fullers earth. It is a soft, earthy substance prepared from hydrous aluminum silicate. It is interesting to note the method of production of fullers earth.

Production of Fullers Earth

The clay is dug from the mine or quarry by means of steam shovels. It is placed in storage bins from which it is transferred, to the crusher by belt conveyors and elevators. The crushers are built of smooth and toothed disks, placed alternately on a shaft. Two systems of this construction work against each other, at a speed of 1000-1100 revolutions per minute. The broken clay passes to a drier six feet in diameter and seventy feet long, revolving at the rate of 15 revolutions per minute. The drier is heated by oil burners and the clay travels counter current with the heat. Incipient blackening of the clay indicates too high a temperature. From the drier it passes to a cooling tank. If lumps are to be found in drying they will be thoroughly dried as the heat of the mass in the cooling tank will be sufficient to take care of them. It is very important that the clay be well dried.

The dried material is then ground on spirally corrugated mills (rollers) and is then bolted. For this purpose silk bolting cloth is used for grades finer than No. 16 mesh. The grades produced are, 15-30, 36-60, and 60-100. The fine clay is mostly produced during grinding process and approximates 15 per cent.

Testing Fullers Earth

Frequently the clay is wet when it leaves the mine and must, therefore, be dried either at its source or at the refinery where it is to be used. For drying, are weighed approximately 400 grams, representing a fair average of the sample received, these are broken into small pieces, the size of an egg or smaller. This quantity is spread out upon a large wax pan, which is placed in a hot oven and allowed to remain until dry (usually overnight). The temperature of the oven should be maintained about 190 degrees F. When dry, the clay is removed and again weighed to determine the loss. The color and fracture of the clay should be noted. A sample of the dried clay should be bottled and retained.

The clay is then ground, making certain that the disks of the mill are set in the same manner. The ground clay is sifted through 30 mesh and 60 mesh sieves. The weights of the fractions coarser than 30, 30 to 60, and finer than 60, are determined. The percentage of 3-60 and finer than 60 are calculated as follows:

$$\text{Per cent } 30\text{-}60 = \frac{\text{Wt. of } 30 \text{ to } 60}{30 \text{ to } 60 + \text{finer than } 60}$$

$$\text{Per cent than } 60 = \frac{\text{Wt. of finer than } 60}{30 \text{ to } 60 + \text{finer than } 60}$$

The fraction finer than 60 is retained together with that coarser than 30. These may be worked up later. The volatile matter of the 30-60 fraction is determined by first cleaning and igniting a platinum crucible in a blast lamp and then cooling in a desiccator. Upon cooling, the crucible is then carefully weighed and from 1.—1.5 grams of the clay to be tested carefully weighed in the crucible. The whole is then heated to a bright red heat for ten minutes and at the end of this time should again be placed in the desiccator and allowed to stand for 30 minutes before again weighing. This is to insure thorough cooling before reweighing, else the clay will absorb moisture while weighing, making accurate weighing difficult. The loss in weight, divided by the weight of the original sample, times 100 will give the per centage of volatile matter.

While the volatile matter determination is in progress, the volume-weight of the 30-60 fraction is determined. A 100 cc. graduated cylinder is weighed. Clay is then poured in up to any line between 35 and 40 cc. graduations. The cylinder is then tapped evenly on the table until the clay no longer settles. More clay is then introduced until 65 cc. or 70 cc. graduation is reached, when the cylinder is again evenly tapped and no more settling is noticed. More clay is added until a line about 3-5 cc. above the 100 cc. mark is reached. The cylinder is again tapped and the necessary addition made to bring the column to the 100 cc. mark when no more settling is noticed. The tapping must be done evenly and uniformly for all clays. The cylinder and contents are weighed. The weight in grams per 100 cc. of clay multiplied by .624 gives the weight in pounds per cubic foot.

Determination of Clay Filter Yields

To determine the filter yields, three percolators are charged each with 65 cc. of the burned 30-60 clay. The same cylinder used in the determination of the volume-weight should be used in measuring the clay in all this work. The cylinder is charged similarly as above until the 65 cc. graduation is reached and maintained after tapping. The clay is then poured into the percolator and again tapped evenly 50 times. Suction is then applied to the bottom of the percolator for about 30 seconds to remove dust. When this has been accomplished the oil is poured into the center of the clay at the top and allowed to soak downward. This is to prevent channeling. When clay has taken up all the oil, add sufficient oil above the

clay level to cause the oil to run into a weighed container at the bottom of the percolator. After the filter has started to flow do not allow oil to settle below the clay level, as this causes an air pocket in the filter which interferes with the rate of flow of oil through the filter. Keep oil above clay level at all times after filter has started to flow.

When filtering spindle and neutral oils, the best filtering temperature has been found to be approximately 90-120 degrees F., and in the filtration of bright stocks, 180-200 degrees F. has been found satisfactory.

The time of charging the stock, the time of the first drop into the receiver, and the time when the color of the total filtrate reaches that of the standard sample, are all noted. The receiver with the filtrate at the color of the standard is weighed and the yield in grams per 65 cc. being known, the yields in gallons per cubic foot, or barrels per ton of clay can easily be calculated. The color standard samples should be excluded from the light when not being used. It is important that this information be obtained prior to using the clay on a large plant scale.

Plant Procedure

The system for naming clays is not difficult. When the clay has been roasted the first time to remove moisture and volatile matter, it is given the name of No. 1 Clay. It is then ready for use in filtering. After filtering oil through it until the filtrate matches the color standard, the filter is washed with naphtha and finally steamed to remove all possible oil, (often referred to as clay soakage). In some cases, as a final step, the clay is blown with air. The clay in this state is known as No. 1½ Clay. Before being able to reuse it, it is necessary to roast it whence it receives the name of No. 2 Clay. A second filtering through the same clay causes it to become No. 2½ Clay. A subsequent roasting brings it to No. 3 Clay, and so on.

One of the kilns used in roasting is lined with smooth bricks, while the bricks that line the other contain cup-shaped depressions, by which the clay is elevated and dropped back. The time of roasting is regulated by the feed into the kiln, this having a constant speed. The degree of heat to which the clay is exposed is regulated by the operator according to various practical tests to which he submits the roasted clay. Incipient fusion can be detected by a certain gritty feel of the clay when placed on the tongue, which is widely different from the usual adherence of the clay to the mucous membrane.

In the case of fusion the volume-weight increases rapidly. When fusion approaches, it can readily be detected by an experienced operator. In case of fusion, the elevated clay falling through the kiln will show lumps of fused material instead of granulated consistency. In general practice two grades of clay are prepared, namely, H. B. clay (highly burned clay), and M. B. clay (medium burned clay). The former contains approximately 2-3 per cent volatile matter and the latter 7-9 per cent volatile matter. The former is used for filtering cylinder oils and the latter is used for filtering spindle, neutral oils and petrolatums. The oil is run through the filters under a pressure of eight to ten pounds. When testing clays for decolorizing power, they may be filtered through a percolator containing 20 ounces of clay.

Regeneration of Clay

The subject of regeneration of clay has been one of vital importance for its further use in decolorizing. All sorts of methods for its so-called purification have been tried, the results of which have been rather discouraging in several instances, but encouraging in others. In general, three types of methods have been applied, namely, (1) solvent method; (2) chemical method; (3) physical method.

In discussing the first, solvent method, it may be said that both straight solvents and mixed solvents have been used. In cases where the solvent method is applied, it is found necessary to combine it with the physical method to obtain the results desired. The solvent method may likewise be used in conjunction with the chemical method. Various solvents have been used such as alcohol, benzol, naphtha, alcohol-benzol mixture, and benzol-naphtha mixture. The extraction of the clay by benzol alone has been found practical but somewhat expensive, due to the fact that a naphtha extraction was also necessary. The action of a mixture of benzol and alcohol (90 per cent benzol, 10 per cent alcohol), upon spent fullers earth from which most of the adhering oil was removed by aid of naphtha and blowing with air, was very slow. On this account too great volume of mixed solvents was necessary in adequately washing the clay. The most practical and economical method of extracting the clay was found by using straight naphtha, approximately 60 degrees Baume gravity. This was found to be the case in washing clays through which not only neutral and spindle oils had been filtered, but likewise bright stocks. An average of 200 barrels are necessary in washing a 20-ton neutral oil filter.

Acid Method of Regeneration of Clays

After the clay has been well washed (naphtha being used), it is steamed for approximately 10 to 15 hours. The amount of clay treated at one time ranges from 40 to 45 tons. In starting a treat, approximately 6500 gallons of sour water (from a previous treat), are pumped into an agitator and agitation by air and steam begun. The clay to be regenerated (approximately 40 tons), is then run into the agitator, after which 7500 gallons of 30 degree Baume sulphuric acid are added. The contents are then brought to the boiling point, and held there while the agitation takes place. After blowing eight hours the contents are allowed to settle eight hours, after which time they are reblown for six hours. This procedure should be followed until the clay has been agitated seven or eight times.

To determine when a batch has been properly treated, a sample is taken while the mass is agitating, is washed with water until the water is clear. A convenient way to wash the sample is to place it in a glass or porcelain dish, mix with water and let settle a minute or so. Decant supernatent liquid and wash sufficiently until water is clear. The clay is then burned in a kiln until it is thoroughly decarbonized. The clay will lose approximately four pounds per cubic foot and should be nearly white or pale flesh color.

When the clay is found to be satisfactorily treated, it is washed as follows:

Fill agitator with water to one foot of the top; agitate well and let clay settle. Draw off the sour water to the amount of 8500 gallons into a sour water tank through cocks above the clay line, 7000 gallons of this wash are used in the next treat. The impurities will be contained for the most part in the remaining 1500 gallons, which are run to the sewer. Continue the washing until the water becomes clear and practically free from acid. This requires about 4000 gallons per ton of clay treated. When washed satisfactorily, the mass is washed with as much water as possible, and while agitating, the bottom cock is opened and the mass let down to the drying tank, where the water is drained off. Superheated steam is then passed through the drier for 12 hours at a pressure of 10 pounds. Compressed air heated with superheated steam is then passed through the drier for 24 hours. Sufficient amount of clay to make room for the next batch is then drawn off. Eighteen inches of clay should remain in the drier to act as a protection to the canvas filter cloth. When it becomes necessary to remove the filter cloth the clay from one side of the drier is piled on the opposite side, the new cloth is put in place and the clay piled on the other side.

Eight to 10 inches of lap should be allowed of the cloth. In practical operations it has been found necessary to remove the cloth every five or six treats. Should any of the clay stick to the tank it can be washed down with a fire hose. It requires three and one-half to four days to acid treat the clay properly and two days washing the clay prior to drying. This method has been found practical in regenerating clay.

Clay Investigations

In studying further the nature of clays it may be advantageous to discuss certain other phases of this subject. No absolute conclusion as to the decolorizing property of a clay can be drawn from the physical properties or the chemical composition of the clay, although in many cases, a light weight clay will be found better than a heavy clay.

The decolorizing power of a clay towards a given stock is independent of its volatile matter contents, as long as this does not consist of hygroscopic water. A clay should be burnt at such temperature that the burnt clay has a minimum fria-

bility without having lost its porosity. It is important to carry out the washing of a used clay with naphtha as far as compatible with good economy. In studying the influence of the rate of heating the clay to the desired turning temperature, it may be concluded that the rate at which the clay is heated to the desired burning temperature in the kiln, does not affect the ultimate volatile matter in the burnt clay to a degree beyond permissible limits.

The length of time of heating a clay at a certain temperature in the kiln has not a very great influence upon the volatile matter of burnt clay, that is, within reasonable limits. Reburning a burnt clay, at the same temperature as that of the first burning, does not change the volatile matter contents. In regard to the size of the charge of raw clay in the kiln, it may be said that within reasonable limits the volatile matter contents of the burnt clay is little affected. A clay burned at the higher temperatures has a lower volatile matter content than when burned at a lower temperature. It has been found that a clay containing pores of very small diameter will require a higher temperature than a clay having wider pores. The relative diameter of the pores and their absolute volume is found from the volume weight and the volatile matter contents of the raw clay, dried to constant weight at 212 degrees F. It was found that the deterioration of a clay is not caused by the accumulation of carbon, or by the repeated heating of the clay alone, but most probably by the combined influence of the heat and carbon upon the mineral matter on the surface of the clay.

As regards the relation between the volatile matter in clay and the decolorizing power of same, the results seem to indicate that the volatile matter content has little, if any, influence upon the decolorizing power of a clay, as long as it is not present as hygroscopic water.

Although it is generally assumed that a burnt clay of low weight per cubic foot has a greater decolorizing activity than a heavier clay, there are numerous exceptions to this assumption.

The ratio between the decolorizing power of various clays is not the same for different stocks. With regard to the chemical composition of clays it was found that a large proportion of free silicic acid present seems to be disadvantageous, and that a large proportion of calcium and magnesium silicates present in the clay is advantageous in its decolorizing effect or power.

Another very important investigation is that of the influence of regeneration of a used clay upon the decolorizing power of the clay. The decrease of the decolorizing power of a clay by regeneration will be the least if:

(a) The used clay is thoroughly washed with naphtha to remove soakage, thus lessening the amount of organic matter therein, which has to be burned off.

(b) That this organic matter is burned off as well as possible.

It has also been ascertained that raw clays give more fine clay on burning than those clays which been burned, which means, in other words, that the burning hardens the clays. However, the production of fine clay is not proportional to the time of burning. The influence of acid treating upon the decolorizing power of a used clay is to decrease it, especially when the clay has been burned only two or three times. With older clay (No. 10 or No. 11), the decolorizing power is improved. If it is desired to burn clays from various sources to desired volatile matter contents, a ground sample of each clay should be dried to constant weight and its porosity and relative size of pores should be compared with known clays. If these have been burned at different temperatures and the volatile matter contents of the resulting burnt clay are known, it will be easy to find the temperature at which to burn the unknown clay.

The decrease of the decolorizing power of a clay is not caused by the accumulation of carbon or by any sintering of the clay due to heating. It is probable that the heating of the clay in the presence of carbon causes changes in the composition of its surface that lowers the absorption power of same. There are numerous theories which have been advanced to explain exactly what takes place between oil and clay during filtering, but since they are so highly technical I deem it unnecessary to take my reader's time to read them. None, so far, seems to be of much practical use.

Use of Clay in Distillation

Besides having a marked effect upon oil in the process of filtering, clays likewise have an effect upon oils in the process of fire and steam distillation. A clay which is used for this purpose on account of its composition, is called magnesite.

After the still has been prepared for charging, a definite quantity of the powdered clay is shoveled into the still. The desired volume of oil is charged to the still and then the fires started. Usually, in this work a pressed paraffine distillate having the approximate tests is used:

Gravity—33.0 degrees.
Flash of—280.
Fire of—335.
Vis. at 100 degrees F.—68.
Cloud of—20.
Color—18 red.

As the light distillates came over, they were examined for color, gravity, and turbidity, and in each case, proved satisfactory. The lack of turbidity was especially noticeable, for it was thought on account of the fineness of the clay used, that some would be carried over in the distillation. However, such was not found to be the case. It was interesting to note that the clay in the reduced oil did not adhere to the bottom of the still in the form of a cake, but was well dispersed throughout the oil. Various methods were applied to remove the clay and the best proved to be that of steaming the oil with water in a tank, and allowing to settle. A separation of clear oil took place. The oil, thus freed from the clay, was blown with air until bright.

A comparative still run was made on the same oil without the use of clay. The residues from each run were filtered through No. 1 H. B. (hard burnt) clay to 2 N. P. A. color with the following filtering yields. In the case where no clay was used in the still during distillation, a filter yield of 145 barrels of oil to 2 N. P. A. were made per 15 ton clay filter, whereas, in the case of the distillation where clay was used in the still, a filter yield of 209 barrels of oil per 15 ton clay filter to 2 N. P. A. color were made. Further comparisons were made on the unfiltered reduced oils with regard to Conradson carbon content, steam test, and percentage sulphur.

It was interesting to note that where the clay was used in the still, the Conradson carbon content of the oil was less than when it was omitted. The steam test showed that where clay was used, the lace formed by steaming, was fine and not present to any appreciable degree; while that formed by steaming the oil without the use of clay in the still, was coarse and considerable, as well as lasting. Relative to the percentage sulphur content in the two oils, it was found that where clay was used in the distillation, the sulphur content was one-half that of the oil distilled without the use of clay.

In summarizing the effect of clay upon the distillation of an oil of the above character, it may then be concluded that the use of clay lessens the tendency of the oil to become discolored. The action caused by its presence does not appear to be due to adsorption of formed coloring matter by the clay (magnesite), but appears to be an actual prevention of discoloration, perhaps by the action of carbon-dioxide (CO_2) formed. In the case where clay was used in distillation of the pressed paraffine distillate, the tendency for the reduced oil to emulsify was greatly decreased. As far as results obtained from actual plant practice, tests on the oils reduced in the presence of magnesite indicate that the quality of the oil appears to be better than any of the oils treated with acid, and to be very little improved by filtration through clay, except in color.

The application of clay in the manufacture of wax was discussed in the articles entitled "Wax and Its Manufacture," published in the December and January issues of this journal by the same authors.

In bright stock manufacture where clay is used to filter naphtha cut-back, as high as No. 12 clay has been used with success. The decolorizing power of the clay used was directly dependent upon the roasting qualities of the kiln. In the filtering of petrolatums it has been advisable to use not higher than No. 4 clay, else comparatively low yields are obtained.

Conclusion: The entire application of clays in petroleum refining covers such a broad field that in one writing it is impossible to cover every phase of the subject. Therefore, as far as the most recent developments as to their various uses are concerned, I shall continue, (some time in the near future) to describe the use of clays in that very important and economical work in the manufacture of lubricating oils, called "clay contacting."

Chemical Control of Grease Manufacture

By C. B. FAUGHT AND F. R. STALEY
Texas Pacific Coal and Oil Company

SIMPLICITY is one of the results of the application of science to industry. It leads to economy and efficiency. Scientific knowledge enables us to accomplish the desired results by the simplest and most direct method. In the development or the perfection of a manufacturing process the chemical engineer studies the effect of each variable in the procedure and establishes the ideal conditions for optimum results. Once these conditions are established it is only necessary to maintain them, since the laws of chemistry and physics state that under identical conditions identical results are obtained. Consequently the chemist has superseded the rule of thumb expert in industry. Modern science respects no secrets and is not satisfied with accomplishment, it continually seeks improvement.

The old time grease maker who learned his art through years of experience after spoiling many batches of material, is too costly for modern competition. He was essentially an artist because he was able to make a good grade of grease from experience and practice without the aid of scientific knowledge or instruments. In spite of his skill many batches were spoiled and continued uniformity of product was rare. Very often he set out to make one grade and when it was ready to ship, it was found to be of another consistency so that a large stock of a slow moving product was accumulated. Lord Kelvin said that unless we can express our knowledge in figures it is of a meagre kind. Unless the variables in a process are measured they cannot be controlled. The chemical engineer measures temperature, pressure and time and weighs each of the raw materials which have been previously tested for uniformity. Herein lies the success of science in grease making.

Equipment

The growing demand for pressure lubricants, cup and gear greases enables the progressive manufacturer to realize excellent profits without a great investment in plant and equipment. A comparatively small plant can be operated at a good margin of profit. The standard grease kettle is steam jacketed and equipped with a stirring device consisting of a motor, driving gears, and rotating paddles to stir the batch. In some plants kettles are mounted on scales so that the materials can be weighed. It is necessary that the paddles and motor are strong enough to stir a full batch of comparatively hard calcium soap. For economy the steam jacket should be insulated.

Nature of Greases

A grease is a solid or semi-solid lubricant. Its lubricating value is due to its mineral oil component and its consistency to a soap gel. The soap content varies from 1 to 30 per cent. The soap is formed by the saponification of a fat or a fatty acid with a base, usually lime or soda. The gel structure is due to the presence of a small percentage of water, from 1 to 5 per cent. The consistency of the grease depends upon the soap content and the nature of the gel. Two greases that have the same soap content, made of the same grade of neutral oil, may have very different consistencies if the conditions are not controlled in the manufacture.

Most greases on the market are made from lime or soda soaps. These two bases produce greases of very different properties. Cup greases, pressure lubricants, and axle greases are usually made with lime, while sponge greases, fiber greases, and gear greases are made with soda. The mineral oils used in the manufacture of greases vary from light neutral to heavy cylinder stock. A pale neutral from 100 to 200 seconds viscosity at 100 degrees F. on the Saybolt viscosimeter, is usually used for cup greases. A cylinder stock or black oil is usually used in greases for heavy gears. In some pressure lubricants bright stocks are used with the neutral oil. Fiber and sponge greases owe their peculiar texture to the soda soap used, since this is characteristic of this base soap. Axle greases are usually made cold from rosin oil and lime. Their manufacture is comparatively simple. Cup greases and pressure lubricants are the most widely used. A high grade uniform product is usually difficult to maintain without the aid of the chemist and laboratory.

Materials

For continued uniformity of product the raw materials used in any manufacturing process should meet definite specifications and each new shipment received should be tested on arrival and, if stored for any considerable period, again tested before using. The raw materials most generally used in grease making are:

1. Lime or caustic soda.
2. Fat or fatty acid.
3. Oil or petrolatum.
4. Dye and perfume.

The best commercial grades of lime and soda should be used. The animal oil used in cup greases is usually 100 pale neutral, having the following specifications:

Flash, 300 to 350.
Viscosity, 100 degrees F. 100 seconds.
Color, 1 to 2.
Cold test, 20 to 30 (paraffine base.)

The manufacturer of grease has a great variety of animal fats, vegetable oils, and fatty acids to choose from. This choice is extremely important as it often determines the cost, the quality of the product, and the time required to make the grease. Animal and vegetable oils are glycerides of the fatty acids, usually stearic, oleic, and palmitic acid. When these are used the glycerine is liberated in the grease kettle, during saponification. Almost any animal fat or vegetable oil can be used to produce soap, but it is often difficult to obtain uniform material, so that it is important for the chemist to see that it meets specifications.

Fatty acids, which are by-products of the glycerine industry, are now widely used in the manufacture of greases. They have many advantages over the fats and vegetable oils since they do not contain glycerine. The chief advantages in the use of fatty acids are: First, uniformity of composition. Second, they usually yield a larger percentage of grease per unit of weight. Third, they are more rapidly and completely saponified. Fourth, the grease formed usually has a better appearance and opacity than that made from fats.

Manufacture

Since cup greases are the most commonly used and the most difficult to manufacture, this procedure will be used as an example. The standard practice is to put a weighed amount of fatty or fatty acid into the kettle with about half its weight of neutral oil. The oil and fat are melted with steam. Usually 10 to 12 pounds pressure is carried on the jacket. The batch is agitated continually by paddles from the start. After the fat is melted the caustic solution or the milk of lime is added. About a 30 degree Baume caustic solution is used. In the case of lime, which is less soluble in water, a slurry is used. In order to avoid lumps this is usually strained through a 100-mesh screen. The theoretical quantity of lime or soda necessary to saponify the fat is determined by the chemist. It will vary with the saponification number of the fat used. The time required to saponify a fatty acid is about two to four hours. The

saponification of a fat or tallow requires a longer time. The most important step in the process is the saponification or the formation of the calcium soap.

After the saponification is complete, the procedure is continued until a comparatively dry brittle texture is obtained. The water content of the soap is extremely important. Too much water gives a soft, pasty consistency. If the saponification is not complete the same consistency results. There are two methods used to control the moisture content. The first is to stop the evaporation when the correct amount of water remains in the batch. This can be determined in the laboratory. The second method is to continue the evaporation until a very dry soap is obtained and then to add a weighed quantity of water. After this water is added the agitation is continued until the water is absorbed and there is no free water in the sample. After the soap is made, the next step is to add neutral oil. This is usually added continuously in a small stream over a period of several hours. Care must be taken not to add the oil too rapidly, which causes lumps in the product, due to chilling. During the addition of the oil the steam pressure is usually reduced. It should be remembered that time and temperature as well as the correct percentage of water is important in the formation of the gel which gives the grease its consistency. The total quantity of oil added should be weighed in order to obtain the desired grade of grease. After all the oil is thoroughly mixed into the batch the grease can be dropped into the filling kettle through a strainer in the bottom of the saponification kettel. This strainer should be made of metallic cloth fine enough to remove small particles of lime or soap. The grease should not be worked after it cools, as this destroys the consistency. It should not be filled into the containers too hot, since this will cause soft centers in the large containers due to slow cooling.

Some manufacturers add a small quantity of perfume, usually oil of myrbane, to cover the somewhat objectionable odor of calcium soap. This is usually added just before filling, since its volatility would cause it to still off if the batch is too hot. Very often the grease is colored by means of aniline dye. This is an oil soluble dye and is dissolved in a small quantity of oil before adding it to the batch. If a light colored neutral is used it is not necessary to use any dye. Some manufacturers add a small quantity of palm oil to the finished grease to give it a polish.

Rosin Oil Greases

Rosin oil greases are made from lime and rosin oil. They are usually sold as axle greases. They are made at atmospheric temperatures without heating. They consist of a lime soap and the mineral oil used is either neutral or black oil. It is very important to have a uniform grade of rosin oil in order to obtain the same results from day to day. Each batch of rosin oil should be tested and a small experimental batch of grease should be made in the laboratory before using the oil in the plant. The manufacture of these greases is comparatively simple, provided the rosin oil does not vary too greatly. Two grades of axle grease are usually sold, known as dark and light axle grease. The light axle greases are made with neutral oil and the dark with black oil. Very often a small percentage of mica or graphite is added to the grease.

If the raw materials and the process is controlled by the laboratory, no difficulty is experienced in the manufacture of greases and a high grade uniform product can be maintained without waste and without the necessity of spoiling a batch of grease. Grease making does not require a highly skilled operator as any man of ordinary intelligence can follow the instructions of the chemist. If the conditions are maintained and the raw material is uniform, grease making becomes routine like any other successful manufacturing process.

Petroleum Division of American Chemical Society Meeting, St. Louis, April 17-19

The Division of Petroleum Chemistry, American Chemical Society, will meet April 17-19, at St. Louis, in connection with the seventy-fifth annual convention of the society.

Twenty-one papers are to be presented at the sessions of the Petroleum Division. A wide range of subjects is covered by the papers which will be of especial interest to those engaged in refining and analysis of petroleum and its products. R. E. Wilson, Standard Oil Company (Indiana), will lead a round table discussion of lubrication and its problems, on the afternoon of the opening day. J. Bennet Hill, Atlantic Refining Company, is chairman of the petroleum division. Carl L. Johnson, Manhattan Oil Company, Kansas City, is secretary.

The program annuonced for the three day meeting follows:

Tuesday, April 17, 2 P. M.

In session with the industrial division.

R. E. Wilson. Round table discussion on lubrication.

Wednesday, April 18, 9:30 A. M.

S. M. Diggs and S. F. Campbell, "Chemistry of Lead 'Soaps' Made From Litharge and Netural Petroleum."

W. M. Faragher, J. C. Morrell and I. M. Levine, "Determination of Olefine and Aromatic Hydrocarbons."

M. C. Alderman, "An Analytical Method for the Separation of Bright Stocks and Neutral Oil Mixtures."

Stuart M. Rodgers and Linden R. Adkins, "A Micro-Saybolt Type Viscosimeter."

Cal B. Coats and George G. Brown, "The Vapor Pressure of Hydrocarbons."

Wednesday, April 18, 2 P. M.

Discussion of A.P.I. projects, led by members of the central petroleum committee of the National Research Council.

Gladys E. Woodard, "The Use of Organic Solvents for the Extraction of High Sulphur Oils from Crude Petroleum."

Gladys E. Woodward, "A Volumetric Method for the Estimation of Sulphur in Crude Oils; An Adaptation of the Nikaide Method."

Gladys E. Woodward, "Silica Gel as a Reagent for the Extraction of High Sulphur Oils From Crude Petroleum."

Charles D. Hurd and Leroy U. Spence, "The Pyrolysis of n-Butane and iso-Butane."

S. C. Lind and George Glocker, "The Action of Electrical Discharge on Ethane."

Thursday, April 19, 9:30 A. M.

H. S. Davis, "Problems in the Analysis of Unsaturated Hydrocarbon Mixtures."

Robert N. Pease, "Thermal Decomposition and Oxidation of the Simpler Hydrocarbons."

P. Bergatron, L. M. Ellis, Jr., and E. Emmet Reid, "Reaction of a Variety of Known Mercaptans in a Naphtha Solution with the 'Doctor' Solution."

F. E. Bartell and F. L. Miller, "Displacement of Petroleum Oil From Oil-Bearing Sands—1. The Degree of Wetting of Silica by Crude Oils."

A. Skinner and G. C. Brown, "True Volatility from the A. S. T. M. Distillation."

Robert A. Baxter, "The Refining of Shale Gasoline."

Thursday, April 19, 2 P. M.

Robert A. Baxter, "The Effect of Variations in Retorting Conditions on the Quality of Oil Produced from Shales."

G. C. Brown, "Antiknock Testing."

J. C. Geniessee and H. F. Huff, "Effect of Volatility of Petroleum Fractions on Detonation Value."

M. Garcia, "Heat Transfer in Oils Flowing Through Pipes."

D. C. Bridgeman, "Dew Points of Air-Gasoline Mixtures From Distillation Curves."

Effect of Size and Shape of Filter On Percolation Filtration

By H. L. KAUFFMAN

LUBRICATING oils are treated with adsorbing substances, usually clays of the hydrosilicate type and, most commonly with that type of clay known as fullers earth, by either one of the following general methods:

1. Filtration through a column of coarse-mesh fullers earth; that is percolation filtration.

2. So-called "contact-process" of filtration.

Any desired degree of refinement can be obtained by either the contact or percolation-filtration methods, and the choice between them depends largely upon practical conditions. One of the main things to be consiedred is whether or not the whole filter product is desired in one particular quality, or whether it is more advisable to have such a product divided into several fractions of various degrees of refinement. Depending to a great extent upon the relative clay cost of the coarse and the fine-mesh adsorbent materials, in the first case contact filtration probably would be more suitable; in the second, the percolation method.

Comparatively recent advances in the means developed for revivifying fullers earth have cause a slight "check" in the development of contact-filtration processes, as a result of which refiners are again becoming more interested in so operating percolation filters as to obtain a maximum efficiency therefrom. This condition has been due largely to the fact that, by the use of the multiple-hearth furnace for revivifying fullers earth, it is now possible to retain the coarse-mesh product in service indefinitely at around 80 per cent of its original efficiency, when about 3 per cent of new earth is added after each burning to make up for losses in handling.

Because of this present renewed interest in the percolation-filtration method of decolorizing and otherwise purifying oils, it was believed that the results of some experiments conducted to determine the relative efficiency of different sizes and shapes of filters would be at this time a matter of general interest. Data on this phase of percolation filtration therefore will be included in the present article.

However, before detailing these results, it may be well to describe the average construction and operating conditions that at persent exist in most refineries wherein the percolation-filtration method is used.

Grades of Earth Used in Percolation Filtration

For this method of filtration, fullers earth of the following grades are commonly made: 16/30 mesh, 30/60 mesh 60/90 mesh. By "60/90 mesh" is meant earth that will fall through a screen of the specific kind, having 16 meshes to the linear inch, and will be retained on a screen having 30 meshes to the linear inch.

The mesh of earth that it is most advantageous to use depends largely upon the characteristics of the oil being filtered. Coarse clays are preferable for the more viscous oils. Clays of finer mesh can be used satisfactorily on oils of lighter body. The finer the clay, the higher is its efficiency as a decolorizing agent; but the slower, with oils of the same viscosity, is the rate of filtration. Experience has shown that 30/60 earth is approximately 20 per cent more efficient than the 16/30 mesh product; and the 60/90 earth, from 10 to 15 per cent more efficient than clay of 30/60-mesh fineness. Ordinarily, neutral oils and cylinder stocks in solution should be filtered through 60/90 clay; steam-refined and bright stocks, petrolatum and wax, through the 30/60-mesh grade of earth. Practical conditions largely influence the mesh of clay to be used.

General Construction of Filters

In decolorizing by percolation, refiners use a vertical type of filter, provided at the bottom with a blanket-covered, perforated drainage-plate to hold the clay; and further equipped with manholes at the top and at one side near the bottom for charging and discharging the clay. The filters vary from six to 10 feet in diameter and from 14 to 30 feet in depth. The depth must be such that the clay and oil will be in contact for sufficient time to result in the removal of a maximum amount of color from the oil. However, if the filters are made too deep (beyond 30 feet), there is the increased danger of "channelling" to be considered. "Channelling" is the term applied to the action that occasionally occurs when the oil passes directly down through the filter without coming into intimate contact with the clay; that is, without being "soaked-up" by the clay. The rate of flow of oil from a filter is dependent upon the diameter. Filters should be designed for a pressure of from 40 to 50 pounds per square inch. It has been found that spent clay in a filter has an angle of repose of 40 degrees. Filters are therefore designed either with cone bottoms, usually on a 45-degree slope, as a result of which they are virtually self-dumping, or with the dished-type of bottom, the advantage of which is the absence of seams.

Various means are employed to hold the clay in the filter and to prevent it from coming-through into the filtrate. The usual method is to place a canvas blanket over the bottom, which blanket is sometimes supported on a perforated screen, while at other times, it lies directly upon the bottom. Difficulty in holding-back the clay is frequently experienced at points where the blankets join the steel shell of the filter and at the necessary opening for discharge of the spent clay. To overcome such trouble, devices ranging from complicated metal attachments to the insertion of old burlap bags in the bottom of the filter have been used. None is entirely satisfactory; for sooner or later (in from six to eighteen months' time), the canvas becomes rotted and frayed and must be replaced. When the blanket is changed, the filter is out of service from one to three days, depending upon the degree of simplicity of its fastening.

A device found to be efficient and satisfactory by many refiners comprises a screen to retain the filtering medium, a clay gate and a manhole —all in one. When a filter has been filled with clay, the damper-type gate and the manhead cover of this filter-head are closed. The clay fills the pack inside of the screen. The clay can not get past the metal sealing-rings into the annular space around the screen. In operation, after the filtered oil has passed through the screen, a pipe tapped into the neck conveys the oil to the run-down tanks. To dump the filter, the cover is swung back on its hinges and the clay gate opened to allow the clay to run-out. The screen is made of heavy, monel-metal cloth, which will give several years wear. When it is necessary to remove this cloth, a new one can be inserted in a few moments' time.

As a guide in the selection of filters, Bell[1] gives the following table of filter capacities:

[1]Bell, "American Petroleum Refining."

TABLE 1

Diameter Feet	Depth	Charging Capacity Tons of Clay	Rate of Flow Gallons per Minute 1	2	3	Average Throughput Barrels per day (Averaged over the Year) 1	2	3
6	15	7	0.50	0.58	0.66	10	14	13
8	20	17	0.88	1.03	1.18	19	26	25
8	25	21	0.88	1.03	1.18	20	27	26
10	20	25	1.38	1.61	1.84	27	38	36
10	25	32	1.38	1.61	1.84	29	41	38
10	30	38	1.38	1.61	1.84	31	43	40

TABLE 2
Filter Capacities
(Courtesy of Hammond Iron Works)

Size	Weight Filter Pounds	Nominal Charge Tons of Clay	Oil Weight (Approx.) Pounds	Total Weight Pounds
5′x10′	4,004	3.5	3,500	14,500
6′x10′	4,687	5.0	5,000	19,700
6′x12′	5,014	6.0	6,200	23,300
7′x10′	5,441	7.0	6,900	26,300
7′x12′	5,818	8.5	8,400	31,300
7′x15′	6,760	10.5	10,700	38,500
8′x10′ 6″	6,281	9.5	9,600	34,900
8′x15′	8,907	13.5	14,100	50,000
8′x20′	10,693	18.0	19,100	65,800
10′x20′	16,300	28.0	29,800	102,100
10′x25′	19,046	34.0	37,700	124,700
10′x30′	21,782	40.0	45,500	147,300

Table 2 gives detailed data concerning the size and weight of filters, nominal charge (in tons of clay) to filters of different sizes, oil weight in pounds (approximate) when the filter is in operation and the total weight of the filter in pounds.

Packing the Filter

In charging filters, best results are obtained if the earth is leveled-off and tamped at least three times while putting the clay into the filter. Such procedure will tend to prevent channelling. Leveling-off and tamping keeps the whole charge of earth homogeneous and keeps the larger grains from rolling to the sides of the filter, under which latter condition a core of fine earth exists in the center of the filter. In a filter that has been improperly charged, the coarse earth next to the sides of the filter will soak-up oil quickly, whereas the fine earth in the center will adsorb oil only very slowly. Consequently, in the filtration process, the oil in a filter thus packed will travel toward the sides and will percolate through the coarse earth, while little or none will filter through the closely-packed earth in the center. Since under such a condition there may be several tons of earth in the filter that are not performing any filtering function, it is obvious that a filter so charged can not give the yield per ton that it should. Further, such a filter is very difficult to drain, wash and steam and the spent earth therefrom causes more trouble in re-burning than does clay from a properly-packed filter.

Other precautionary measures to be followed in reducing the tendency of oil to channel include either the insulation of the outside of the filter or the placing of same in a tight compartment where the temperature of the earth and of the oil will remain almost constant throughout the entire run. Then be sure that the earth is at the correct temperature as it is charged to the filter and that the oil, likewise, is at the proper temperature for most efficient filtering results at all times.

Filtering the Oil

The temperatures at which oils are filtered varies with the viscosity of the oil. Un-diluted cylinder stocks require the highest temperature: for best results, this temperature should not be over 150 degrees F., although some refiners still filter at temperatures around 160-170 degrees F. More often, however, cylinder stocks are filtered either in 50-50 or 60-40 naphtha solution at a temperature of about 125 degrees F. Neutral oils should be filtered at a temperature of not over 100 degrees F.; waxes and petrolatums, at a temperature of about 25 degrees F. above their melting points.

Filtration may take place either with gravity or pressure feed, although the latter method seems to be preferred. After the filter has been charged with clay, the manhole at the top of the filter is closed. The oil to be purified is now pumped in through a line at the top of the filter, under a small pressure (5-6 pounds), until the oil begins to "show through" the clay. Thereafter, the pressure is increased to about 15 pounds. The first oil is light in color, gradually getting darker as filtration proceeds. Oil is pumped through the filter until the blended filtrate reaches a color standard previously established. Both the oil pressure on the filter and the rate of flow should be constant for the entire run. It is good practice to have installed in the line, at some point between each filter and either the common tank or the manifold leading into the tank, a device that will control and keep uniform the speed at which the filter is running.

One filtration is sufficient for neutral oils, waxes and petrolatums when filtered to the usual colors. Cylinder stock, either undiluted (that is "straight") or in naphtha solution, generally requires several filtrations. The unfiltered stock is first passed through a filter containing clay that has very little decolorizinz value. The effluent from this filter may then be directed to two or more filters, filtered oil from which is "off-color." It is from these filters that the filtrate is secured to soak-up newly-charged filters and to supply filters running on-color." By means of a closed system this may all be done with the original pumping, starting at 35-45 pounds pressure, the oil thence passing through the filters and heaters in the required order. By such an arrangement contact of the oil with the air is avoided. Oil thus handled filters with the greatest facility.

Anti-gravity Filtration

Some refiners use the anti-gravity system of filtration; that is, the oil is pumped up through the clay instead of allowing it to percolate downwards, as a result of which approximately 20 per cent greater efficiency is said to be obtained from the clay. However, when this method of filtration is used, it is particularly necessary that the filters be strongly reinforced.

Anti-gravity filtration is especially adaptable to the filtration of transformer and other non-viscous oils and for filtering naphtha solutions of cylinder stocks and long residuums. Consequently, its use is limited almost exclusively to the filtration of the types of oils just mentioned.

In filtering oils anti-gravity, it is important that just sufficient pressure be placed upon the oil as to insure its passing evenly through the clay, and yet low enough so that the pressure applied does not lift and float the earth.

One refiner, in the anti-gravity operation of filters of 20-tons capacity on naphtha-solution of long residuum, charges 19 tons of clay to the filter. This leaves sufficient space at the top of the filter for the oil to collect. A gravity tank, which is merely a 55-gallon open-top steel drum, is placed slightly above the level of the clay-charging floor at the top of each filter and is kept filled with oil pumped from the storage tank below. This gravity tank is fitted with a regulating valve which, in turn, is operated by a float contained in the tank, as a result of the use of which float a constant head-pressure of 4½ pounds per square inch is maintained on the oil in the filter.

From the bottom of the gravity tank the oil flows through a two-inch line

into the bottom of the filter, the continuous head pressure of the oil from above forcing the mixture slowly and evenly up through the body of the clay. In the space in the filter above the clay bed, the oil is continuously drawn off through a pipe, the end of which stands up about six inches above the top of the clay. This outlet pipe is protected by a strainer, thereby preventing the withdrawal with the oil of any particles of fullers earth that might have floated to the top.

In this connection the data shown in Table 3 on the anti-gravity filtration of steam-refined lubricating stock that had been diluted with gasoline prior to filtration (so-called "cut-back" stock) become of interest. This table shows not only the temperature rise at the beginning of the filtration, indicative of a reaction of some sort, either chemical or physical; but it is also a further proof of so-called "Day's phenomenon," namely, that the filtration of a petroleum oil through a finely-porous medium results not only in the decolorization of that oil, but also a separation of same into fractions of various gravities, viscosities, and so forth.

is introduced into the filter to displace both the naphtha and the oil washed from the clay by the naphtha. If deemed advisable, the washings are repeated until the color of the naphtha used for this purpose shows that all naphtha-soluble oil has been removed from the clay. The clay in the filter is then steamed at a pressure of about 40-45 pounds, continuing steaming until the clay is naphtha-free (indicated by the fact that the condensate shows the presence of no oil) and thoroughly dry. This requires approximately from 15 to 18 hours. There should be a steam-pressure reducer, steam-gauge and a water-separator on the steam-line near the filter. While steaming the filter, it is advisable to "choke-in" the outlet to be sure that the steam is reaching all of the earth. When the clay is dry, the pressure is released and the filter-head removed to cool and dry. The oil and naphtha are recovered from the washings by distillation.

Here it might be mentioned, too, that the anti-gravity method of filtration makes washing of the filter much easier. This is due to the fact that all the impurities extracted from the oil down through the entire column of clay.

Rates of Filtering

In Table 1 on filter capacities are given data as to average rates of flow in gallons per minute and average throughput in barrels per day. Concerning these figures Bell[2] states: "In the table on filter capacities, the oils are grouped under three classifications, and the figures are based upon average conditions. The figures may be used with safety, since every installation will have several filters, so that the retarded operation of one unit will usually be balanced by better results obtained from others."

Filter cycle.—Idle time is always a matter worthy of grave consideration in filter-plant operation; hence, every possible effort should be made to reduce this to a minimum. Below are shown data taken from a filter-plant report (which plant is equipped with 10 filters and in which both viscous and non-viscous neutral oils, cylinder stock in solution and wax are filtered) as to the time involved in the various operations:

Construction Details for Filters

A. D. Smith, in Day's "Handbook of the Petroleum Industry," comments so capably on the details of construction and the specifications for percolation filters that his remarks on this subject will be quoted below in full:

"In view of the fact that two refiners rarely agree as to the most advisable size of filters, or the ratio of length to diameter, there are obviously no uniform standards of construction. However, it may be said, in general, that filters are usually built in cylindrical form, and while almost any diameter and height can be found in service, units of five feet diameter by 10 feet in shell, and those of eight feet diameter by 20 feet in shell have found considerable favor in various plants.

"Occasionally, filters are constructed in conical form, slightly deviating from cylindrical, in order that the earth may pack lighter and so prevent the channeling of the oil in actual operation. The heads should be either of cone or dished type, the latter being preferable on account of the absence of seams. In fact, if it were not for the present high cost of this type of construction a smooth seamless surface throughout would be highly desirable, as it would insure uniform packing and

TABLE 3
Anti-Gravity Filter Fractionation Data on "Cut-Back" Steam-Refined Lubricating Stock

Description	Original Stock	First Stream Thru Clay	After 10 Bbl. Yield	After 23 Bbl. Yield	After 75 Bbl. Yield	After 148.4 Bbl. Yield	After 294 6 Bbl. Yield	After 500.4 Bbl. Yield	After 589.4 Bbl. Yield
Temperature of filter stream (deg. F.)	...	106	136	118	106	84	68	68	68
Gravity	41.6	49.0	48.3	46.2	43.2	42.4	41.9	41.8	41.5
Sulphur (per cent)	0.134	0.011	0.020	0.045	0.080	0.128	0.125	0.133	0.129
After Reducing									
Gravity	23.0	30.7	29.7	27.7	25.4	23.9	24.1	22.9	23.3
Flash	430	460	480	440	420	435	470	440	440
Fire	540	535	540	540	525	540	545	540	535
Vis. @ 100 deg.	3,122	819	892	1,148	1,937	2,291	2,662	2,722	2,798
Vis. @ 210 deg.	156	90	87	95	125	135	140	140	140
Pour	60	55	55	55	65	65	65	65	65
Iodine value	18.0	0.61	1.2	4.3	12.1	14.8	16.4	17.4	18.1
A.S.T.M. Carbon residue (per cent)	2.25	0.008	0.027	0.115	0.546	0.932	1.49	1.61	1.79

Draining, Washing and Steaming Filters

After the fullers earth has adsorbed coloring matter and other impurities to the limit of its capacity, filtration is stopped and the filter allowed to drain. Draining is generally accelerated by the use of air pressure or steam. The use of steam both aids in draining and in cutting-out the slime that is deleterious to efficient filtering. Light naphtha is then pumped through the filter, using about six or seven barrels of naphtha for each ton of clay. Naphtha of 52 degrees to 56 degrees gravity, or even higher, is desirable for best and most economical results in washing. After the clay and naphtha have soaked for several hours at a temperature of about 150 degrees F., steam are near the bottom of the filter and are relatively easy to wash out from above as compared with the washing of a filter through which the oil has been passed downward. In the latter case the carbon and difficultly-soluble asphaltic particles, etc., are all near the top of the filter and must be washed

[2]Bell, "American Petroleum Refining."

	This week (All 10 filters)	Av. per day (All 10 filters)	Last week (All 10 filters)
Hours packing filters	39	6	45
Hours soaking	69	10	65
Hours filtering	942	132	912
Hours steaming and washing	189	24	173
Hours dumping	37	6	44
Total cycle	1276	176	1239
Hours capacity	1680	240	1680
Hours idle time	404	441	64
Per cent of idle time	24.00	...	26.25

no chance of off-colored oil from the portions of the charge left in the seams. For this reason many specifications call for welding of seams—an excellent idea where the objective is extremely light-colored oils or petrolatum.

"All man-necks should be of substantial wrought construction, and cast iron should be avoided. This is true particularly in the quick-opening type of manhead with yoke and screw, as serious fires and loss of life have resulted when a plate of this type has let go under excessive pressure. This is likely to occur under certain conditions, during naphtha washing. The swing-bolt type of head is fairly satisfactory in extra heavy cast-iron construction, but may be rendered much safer by being fabricated from wrought material. All necks and plates should be faced for a corresponding distance, to avoid any possible chance of leaks, which are highly dangerous when washing with hot naphtha. For the same reason, the flanges should be of boiler type and the general workmanship of the best.

"False bottoms may be flat, of segmental plates, resting on suitable angle frames, or of sectors taking the general shape of the bottom. Such a type is more often used in filters with a bottom, earth-discharge outlet. The latter may be of special construction or a simple cast-iron plug may be used. The plug is withdrawn from the bottom flange when the filter is ready to dump, the cloth immediately above, over the false bottom, being slit with a long-handled knife, and so allowing the charge to empty itself.

"Where small apertures are used for withdrawing the earth, it is assumed that the latter is washed and steamed dry in the filter. Such practice is practically universal in this country today, the older method of transferring an oil-soaked charge to a special wash-filter being almost obsolete. A six-inch opening is amply sufficient to allow the thoroughly washed and steamed, dried earth or bone to flow freely, although obviously a filter cannot be emptied so quickly with such an opening as with special gates of larger area."

In this same volume (page 65), Smith also gives the following specifications for a vertical type of filter, eight feet in diameter by 20 feet high, in the shell.

"Shell.—Shell shall be made of four roundabout courses of the best quality of tank steel of the following weights:

First ring .....15.30 pounds
Second ring .....15.30 pounds
Third ring .....12.75 pounds
Fourth ring .....12.75 pounds

"Heads.—Heads shall each be made from one piece of 17.85-pound plate best quality flange steel, standard O. D. and flanged-in.

"Lugs.—Each filter shall be provided with four C. I. lugs 18 inches wide by 24 inches long, lugs to be centered 90 degrees from each other. Bases shall lie in a line 5 feet 6 inches above bottom of shell.

"Riveting.—All riveting shall be in accordance with the following schedule:

Rings	Riveting circular seams	Riveting vertical seams
1 to bottom head	¾-inch R., 3-inch P., D.R.L.	¾-inch R., 3-inch P., D.R.L.
1 to 2	¾-inch R., 3-inch P., D.R.L.	¾-inch R., 3-inch P., D.R.L.
2 to 3	¾-inch R., 2¼-inch P., S.R.L.	¾-inch R., 3-inch P., D.R.L.
3 to 4	¾-inch R., 2¼-inch P., S.R.L.	¾-inch R., 3-inch P., D.R.L.
4		¾-inch R., 3-inch P., D.R.L.
4 to top head	¾-inch R., 2¾-inch P., S.R.L.	
	Lugs to shell 7/8-inch R., 2½-inches P.	

"Caulking. — All seams shall be caulked.

"Flanges.—The following sizes shall be furnished for each filter:

1 3-inch outlet flange, centered on the bottom of filter.

4 2½-inch service flanges, located on top of filter, on a line directly over line passing through centers of any two opposite lugs, centered equidistant from shell sides 1 foot apart.

"Man-necks.—Each filter shall be provided with two plate man-necks; one 18-inch diameter centered in the top of filter; one 18-inch diameter ends by 36 inches long, centered with long axis parallel to long axis of filter as close to bottom as good practice will allow, directly under either lug at 90 degrees to top row of flanges. Top plate will be secured by 22 ¾-inch standard bolts, side plate requiring 50 of same size.

"Gratings.—Each filter shall be provided with a set of gratings or false bottom, of 15.30-pound plate, to be supported 6 inches above bottom, by a 3/8-inch by 3-inch by 3-inch angle ring riveted around inside of shell, and by four angles of same weight riveted across shell. Grating plates shall be cut in strips sufficiently narrow to pass readily through man-neck, shall rest without fastening on supports, and shall be perforated with ½-inch holes on 1½-inch centers.

"Testing.—Filters shall be fabricated in shop, and tested under 75-pounds hydrostatic pressure."

Figure 1 shows the details of construction of a lubricating oil filter, eight feet in diameter by 20 feet high, in the shell.

With the foregoing construction details of percolation filters in mind, and the manner in which refiners usually conduct the filtering process, we can now go on to a discussion of experiments conducted to determine the relative efficiency of different sizes and shapes of filters.

Results of Experimental Work

Five different filters of the sizes and shapes shown in Figure 2 were constructed for carrying out the experiments.

"100 E" pale oil (also known as "28" pale oil) having a Lovibond color of 65 on a six-inch cell was used as a stock oil in all experiments.

Below are shown the colors obtained on the first 20 gallons through and the weights of clay in each filter:

	No. 1	No. 2	No. 3	No. 4	No. 5
Color (Lovibond, 6-inch cell)..	16	17	34	8	10
Weight of clay in pounds....	92	92	23	368	92

From results obtained with filters No. 1 and No. 2 it would appear that there is only a very slight difference

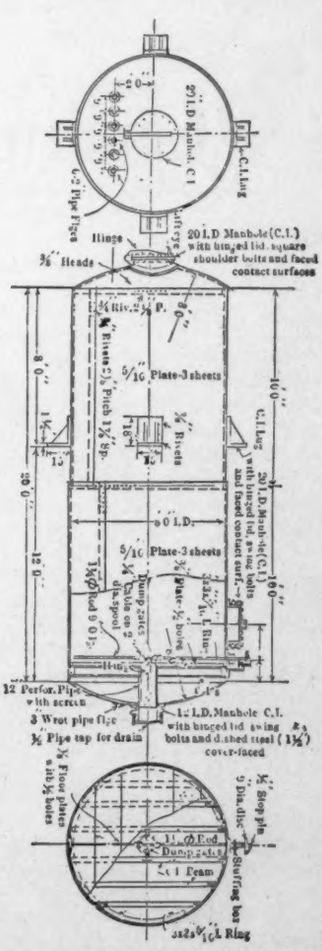

20 I.D Manhole C.I.
C.I. Lug
Hinge
¾" Heads
20 I.D. Manhole (C.I.) with hinged lid, square shoulder bolts and faced contact surfaces
¾" Rivets
5/16 Plate-3 sheets
C.I. Lug
20 I.D. Manhole (C.I.)
0 I.D.
12 Perfor. Pipe with screen
3" Wrot pipe flge
¾" Pipe tap for drain
16 I.D. Manhole C.I. with hinged lid swing bolts and d.shed steel (1¼") cover-faced
¾" Floor plates
¾" Stop pla
Stuffing box
Ring

FIGURE 1

Construction details of lubricating oil filter, eight-feet in diameter by 20 feet in the shell. (Day's Handbook of the Petroleum Industry.)

in the efficiency of a cone-shaped filter over one with straight walls. As regards convenience of handling, No. 1 filter would be preferable in view of the fact that for the same head of oil this type of filter will hold 2.2 times as much oil as a straight-wall filter of the same height as No. 1.

The respective diameters on filters Nos. 2, 3 and 4 were 12 inches, 6 inches and 24 inches; the respective Lovibond colors on a six-inch cell of the first 20 gallons through were 17, 34 and 8; while the respective weights of clay were 92 pounds, 23 pounds and 368 pounds. From these results it appears that, given the same column of clay and the same head of oil, the quality of the filtered oil is in a definite ratio to the diameter of the filter—in these particular experiments the numerical color of the filtered oil varying in direct proportion with the diameter of the filter. For, the diameter of No. 3 filter was six inches; No. 2 filter, two times six inches or 12 inches; and No. 4 filter, four times six inches or 24 inches; while the respective colors were 34, 34/2 or 17 and 34/4 or 8.5. Furthermore, using the same column of clay and the same head of oil, in order to obtain twice as good a color (speaking in a numerical way of Lovibond readings on a six-inch cell), four times as much clay must be used. The amount of clay used in the six-inch filter (No. 3), when the Lovibond color of the filtered oil was 34, was 23 pounds; on the 12-inch filter (No. 2), Lovibond color of 17 on filtered oil, the amount of clay used was four times 23 or 92 pounds; while on the 24-inch filter (No. 4), Lovibond color of 8 on filtered oil, the amount of clay used was 16 times 23 or 368 pounds.

No. 5 filter is of the same diameter as No. 3 filter, but the column of clay in No. 5 filter is four times the height of the column in filter No. 3. The Lovibond color on a six-inch cell of the first 20 gallons through No. 3 filter was 34; of a similar quantity of oil through No. 5 filter, 10. Assuming No. 5 filter to be 100 per cent efficient, then No. 3 filter is only about 30 per cent as efficient, disregarding a consideration of the weight of clay in each filter.

Comparing filters No. 2 and No. 5, it is to be noted that the dimensions of these filters were, respectively, 12 inches in diameter by three feet six inches in height; and six inches in diameter by 12 feet six inches in height. No. 5 was designed to hold the same amount of clay as No. 2 (92 pounds), but the column of clay in No. 5 was 12 feet or four times the height of the column in No. 2 filter; while the diameter of No. 5 filter was only half that of No. 2. The Lovibond color on a six-inch cell of the first 20 gallons through No. 2 filter was 17; and through No. 5 filter, 10. Assuming again that No. 5 filter is 100 per cent efficient, then the efficiency of No. 2 filter would be about 59 per cent, based on a numerical comparison of the Lovibond colors obtained. True, this seems to be a poor basis of comparison, but it suffices for these purposes.

The filters in use at the particular refinery where these tests were carried out had a top diameter of 12 feet, a bottom diameter of 10 feet and a height of 11 feet 10 inches. This is approximately equivalent to a straight-wall filter with a diameter of 11 feet and a height, also, of 11 feet. The average clay charge per filter is 20 tons.

As a result of these experiments, the use of filters 22 feet in height and 7 feet 10 inches in diameter was recommended, filters of this size also having a capacity of 20 tons of clay.

These experiments had only to do with a comparison of the effects of variations in size and shape of filters. Of even greater importance is the effect of the grade and mesh of clay used. So, too, must be considered the rate of flow, since this has much bearing on the filter cycle.

Casinghead Gas Contracting

By T. R. GOEBEL

Manager Gas Contracting Department, Skelly Oil Company in Skelly News

INASMUCH as the casinghead gas contract is the economic basis of purchasing raw material for our gasoline plants, one cannot discuss it without touching upon the things men in this important branch of the petroleum industry are thinking about, the purchase price of gas, abandoning and consolidation of plants and building of new ones.

Co-operation! That's the word. And yet it almost sounds like a banality. It's as much used as efficiency and psychology. Nevertheless, co-operation is the best single word descriptive of the tendency in casinghead gas contracting nowadays. And it is co-operation in earnest manifested in acts rather than protestations. Man is rather an individualist than a co-operator, but necessity forces him to co-operate. So it is in the gasoline business. The year 1927 will always be known as one of almost unprecedented depression in the petroleum industry expressed in absurdly low prices for its products.

Regardless of the causes, low prices have existed practically all of this year and how much longer they will continue is difficult to prophesy. But we have been and still are confronted with the necessity of manufacturing gasoline to sell at current prices at a profit. To do this every possible reduction has been, or is being, made in the manufacturing departments of business.

With this same object in mind much thought has been given to the consolidation of plants or even their abandonment and to a general reduction in the price paid for gas.

It should be explained that gas is generally purchased on a basis that is flexible enough to give effect in the purchase price to the fluctuations in the sales price of gasoline. In other words, casinghead gas is usually purchased by paying a certain fixed proportion of the value of the gasoline produced from the gas so that a reduction in the sales prices of casinghead gasoline will automatically lower the purchase price of the gas, and by this same token an increase in the sales price of the finished product will raise the purchase price of gas. The sort of reduction, however, that is being given considerable thought is one comprehending a reduction in the *proportion* of the value of the gasoline paid for the gas. Common necessity is causing many concerns to turn to co-operation as their chief aid in effecting a necessary reduction in the price of their raw material for plants now in operation and also for new plants.

In times gone by, and not so very long ago either, the appearance of a casinghead gasoline situation usually was the signal for the like appearance of a number of competing gasoline plants. The result was too much competition, uneconomic contracts at times, *overbuilding the situation* and like undesirable consequences. More may be said at another time about the evil of overbuilding for a given situation. Nowadays the tendency, at least, is to invoke the aid of co-operation in this important matter to the end that one comprehensive plant will be erected to adequately take care of the casing-head gas requirements of the area. The result is a plant built without haste, proper, conservative, yet fair gas purchase contracts, economical construction and no unnecessary overbuilding.

Should an area be such where two plants are to be installed favor is being shown the idea of dividing the situation geographically so that one plant would serve one part of the area while the other plant would serve the remaining part. This also has a decided benefit in cur-

tailing investment in gathering and residue lines.

In situations where there are several plants with one pre-eminently fit to survive determined by the size of its reserve of gas, its production and other factors the owners of the smaller plants are not hesitating in the outright disposition of their production to the larger plant. Of course, this is being done chiefly where the smaller plants have been operated at a loss during the continuance of a depressed market. Such a policy has the effect of lowering manufacturing costs to the enlarged plant and eliminating whatever loss the smaller plant or plants may have been incurring.

Where concerns have plants in more than one area and situations are such that they could be economically consolidated much thought is being given to the advisability of trading production in one area for production in another area. The end in mind is the elimination of plants wherever economic and advisable with the resultant increase in the production of the remaining plants. To illustrate: If Skelly Oil Company has a plant in each of areas one and two and another company has plants in the same areas the thought is for Skelly to trade its production in, say, area one to this other company in exchange for the second company's production in area two, thus resulting in two plants rather than four. Naturally the production of the plants involved must be essentially comparable, the output in gallons must be somewhat the same and the character of the gas processed, the formation from which the gas is produced and the contractual provisions must all be enough alike to make a trade possible. A cash consideration might conceivably be given to equalize an otherwise unequal proposition.

Much might be written on this entire subject but even in the compass of this article we trust we have outlined some of the high points that indicate the trend in casinghead gas contracting. The results of all this should be smaller manufacturing costs and greater profits.

It is sincerely hoped that the lessons taught in this year of depression will never be forgotten and that the inevitable upward swing will not cause any of us to swerve from our co-operative, conservative course.

National Petroleum Association Meets April 19-20

THE Semi-Annual Meeting of the National Petroleum Association will be held this year, as in the past, at Riverside Hotel, Cambridge Springs, Pennsylvania, on April 19 and 20. Trustees of the association have had the program for this convention under consideration since their November meeting and much work has been done by the program committee in an effort to make the coming convention as interesting, constructive and useful to those in attendance as possible.

The sessions will be given over to presentation of informative papers and discussion dealing with such vital subjects as "Welfare and Insurance"; "Refining", which includes the discussion of Economy of Efficient Combustion, Filter House Problems, and Treating Light Distillates; "Membership and Relations"; "Trade and Commerce"; and "Traffic and Transportation."

During the evening of the first day, April 19, those in attendance will view the "Story of Petroleum," a motion picture prepared by the Bureau of Mines, and "Atlantic City Scandals," which includes moving pictures taken by F. G. Clarks during the Atlantic City convention last fall.

Members of the association and visitors expecting to be present at Cambridge Springs have been urged to make their reservations at the Riverside Hotel as early as possible.

Following is the program as outlined for the meeting:

Thursday Morning, April 19, 10 A. M.

Keynote Address—E. M. Lyons, president, National Petroleum Association.

"STANDARDS AND TASTES"

A. W. Scott, presiding.

(a) "How to secure Greater Uniformity in Testing"—*Dr. Charles V. Bacon.*

(b) "Cloud-Fluidity-Pour and Cold-Test" —*E. M. Keeley, Crew Levik Company.*

(c) "Volatility and Distillation of Motor Oils"—*E. E. Bown, Emery Manufacturing Company.*

(d) "Fundamental Research in Petroleum."—*Dr. R. P. Anderson, American Petroleum Institute.*

(e) "Activities of the Department."—*A. W. Scott, Trustee-in-Charge, Department of Standards and Tests.*

"WELFARE AND INSURANCE"

R. A. Wotowitch, presiding.

(a) "What we can do."—*James H. Herbert, president Fire and Safety Marshals of the National Petroleum Association.*

(b) "The Warren Group."—*James F. Sweeney, Viking Oil Corporation.*

(c) "The Bradford Group"—*A. Mulhaupt, Kendall Refining Company.*

(d) "The West Virginia Group."—*W. D. Manz, Tri-State Refining Company.*

(e) "The Oil City Group."—*Wayne K. Glenn, Pennsylvania Refining Company.*

(f) "Fire Prevention."—*Frank G. Benedict, Sinclair Refining Company.*

(g) "First Aid Training." (with demonstration).—*J. J. Forbes, Supervising Engineer, United States Bureau of Mines.*

Thursday Afternoon, April 19, 2 P. M.

"REFINING"

P. S. Tarbox, presiding.

(a) "Economy in Efficient Combustion." —*H. A. Ross, Combustion Engineer, National Petroleum Association, Cooperative Engineering Service.*

(b) "The Advantages and Opportunity of the Small Refinery."—*H. S. Bell.*

(c) "What Pennsylvania State College can do for the Pennsylvania Oil Industry." — *Dr. Reiss, Pennsylvania State College.*

(d) "Filter House Problems."—*H. R. Lewis, Conewango Refining Co.*

(e) "Treating Light Distillates."—*By a representative of the Bureau of Mines.*

(f) Reports from Groups: Bradford, Warren, Oil City, Pittsburgh.—*Arranged for by P. S. Tarbox.*

Thursday Evening, April 19
Fellowship Supper

Film—"Story of Petroleum." (*U. S. Bureau of Mines.*)

"Atlantic City Scandals."—*F. G. Clarks' Atlantic City films.*

Friday Morning, April 20, 9:30 A. M.

"MEMBERSHIP AND RELATIONS"

(a) "Membership."—*O. P. Keeney.*

(b) "The Oil Industry and the Public." —*Trell Yocum, American Petroleum Institute.*

"TRADE AND COMMERCE"

H. A. Logan, presiding.

(a) "Knowing the Facts." — *H. W. Schmidt, United Refining Company.*

(b) "What do the Figures Show?"—*By a Petroleum Economist.*

(c) "Is the Refining Branch of the Industry Helpless in the Present Situation?"—*G. C. Davison, Tri-State Refining Company.*

(d) Program for the functioning of Marketing Groups.—*H. A. Logan, United Refining Company.*

"Refinery Accounting."—*T. J. Hilliard, Waverly Oil Works Company.*

Treasurer's Report.—*G. B. Hunter, Treasurer, National Petroleum Association.*

"What the Association Stands for and What it is Doing."—*Fayette B. Dow.*

Friday Afternoon, April 20, 1928

2:00 P. M.

"TRAFFIC AND TRANSPORTATION"

Willis Crane, presiding.

Treating California Straight Run Gasoline

By E. N. KLEMGARD

WHILE the attention of refiners and oil technologists has been centered on the manufacture of anti-knock motor fuels, particularly gasoline produced from various types of cracking plants, the fact that enormous quantities of straight run gasoline requiring some form of chemical treatment are being produced daily has not been overlooked. The refining of straight run gasoline is an important and essential operation at practically every large refinery, however there is often a doubt in the mind of the refinery executive as to the extent to which it is a profitable operation. Where the refinery is functioning to produce one or two grades of a highly standardized gasoline in which the variations in specifications are limited it is advisable to keep a close watch on the quantities of chemicals applied, deterioration of equipment and the amount of labor required in order to keep the cost of treatment at a minimum. Along this line many of the larger refiners have conducted extensive researches with the object in view of groducing marketable straight run gasoline at as low a cost as possible.

It is obvious that the extent of the refining operations will depend almost entirely on the quality of the gasoline desired.

Color of Gasoline

The object of considerable advertising matter appearing in the press throughout the country during the last few months has been the eduction of the public to the belief that the color of a gasoline is not an indication of its quality. While from a general consideration this may be true, it should not be overlooked that a yellow or off color gasoline usually denotes that the product has become contaminated with a darker oil or has had insufficient refinement. Of course it is now possible to purchase motor fuels of various colors, such colors as red, blue, orange and yellow being well known on the market, and are produced by the addition of very small quantities of oil soluble dyes. It is of interest that one large eastern manufacturer who employs a blue dye in his product found that the gasoline, before the addition of the dye, must be of 21 Saybolt or better as a slight yellow color with the blue dye produced an unsatisfactory greenish appearing product. From a sales standpoint it is believed that a customer would prefer a colorless or clear gasoline which he can be reasonably sure has been either acid or clay treated, to a yellow product the use of which might possibly lead to objectionable gumming of the valve stems of his motor.

In the case of certain gasolines produced from Mid-Continent or Pennsylvania crudes it has been found that a product of water white color may be produced by straight distillation, and in such cases where the gasoline has a satisfactory odor, and will meet the specification for sulfur content and the corrosion test it is possible that chemical treatment may be omitted without any appreciable reduction in the quality of the finished product. It is of note that before the gasoline is shipped some kind of color stability test should be made. This may be simply carried out by exposing the gasoline in a glass bottle (after filtering through dry filter paper) to strong sunlight for two or three days. Some manufacturers hold samples in one gallon cans for one or two months after shipment in order to note color stability and other changes which may occur on storage or in transit. A darkening in color is usually accompanied by a slight deposit of an oxidized, gummy appearing substance. Straight run gasoline from California crudes often give gasolines of a pink tint, which forms a pink sediment in storage.

Some refiners find it desirable to refine their straight run gasoline to a color of 25 plus and maintain a standard of 21 plus on all gasoline leaving the refinery. In some cases where gasoline has gone off color while in transit or storage it has been possible to bring the color back to standard by the application of small quantities of contact clay while the product was in the storage tanks.

Corrosion

The allowable quantity of sulfur it is safe to leave in gasoline without danger of corrosion of the motor parts has been a much debated subject for several years. Jacque C. Morrell, stated at the meeting of the Petroleum Division of the American Chemical Society held in Detroit, September 5, that in some sections of the country, gasoline as high in sulfur as .5 per cent is being marketed with apparently no ill effects. However results have been reported by S. H. Diggs, chief chemist Standard Oil of Indiana at Casper, Wyoming, in his paper on "A Study of the Effect of Sulfur in Gasoline On Wrist Pin Corrosion in Automobiles," showing that for a gasoline containing .04 per cent sulfur that there was no corrosion but the water condensing in the crankcase of the motor used in the test did contain a small amount of iron sulfate. For gasoline containing .151 per cent sulfur appreciable corrosion was noted and the water in the crankcase contained a small amount of sulfuric acid. Gasoline containing .458 per cent sulfur was found to be very unsatisfactory. The conclusion is reached that the limit of 0.1 per cent of sulfur allowed by the Federal Specification Board if increased would be accompanied by considerable danger. While the specifications of this board are not enforced except for those products bought for government use, they are in use by many refiners as standards.

The corrosion test usually made by the refiner before shipment of gasoline is that known to the trade as Method 530.21, U. S. Bureau of Mines Bulletin 323A. In brief this is a "copper strip test" carried out at 122 degrees F. for a period of three hours. One of the large California refiners make the corrosion test by exposing the copper strips for three hours at 170 degrees F. thus providing a wide margin of safety in regard to corrosion. The copper dish or copper bowl test is some times specified for straight run gasoline, and while this test is more applicable to cracked gasolines high in gum forming constituents, it also indicates the presence of dissolved elementary sulfur or combined sulfur compounds having corrosive effects. The straight run gasolines from the California crudes very seldom give any appreciable weight of gum in the copper dish test. Treatment of the gasoline for the removal of the free elementary sulfur will be taken up later. While the dissolved free sulfur forms black copper sulfide in the corrosion tests, the following organic sulfur compounds which may occur in gasoline are also effective; mercaptans, hydrogen sulfide, alkyl sulfates, sulfonic acids, akyl sulfides, alkyl disulfides, sulfoxides, carbon bisulfide and thiophene.

Doctor Test

The doctor test is demanded in many cases by jobbers as an indication of the "sweetness" of the gasoline they may be purchasing. It is well known that the doctor test is not a criterion of the utility of the gasoline as a motor fuel since it only indicates the presence of a class or certain type of sulfur compound, and gives no information as to the total amount of sulfur in the fuel. Certain mercaptans having a very offensive odor are indicated by a positive doctor test, however, there may be present considerable quantities of sulphur bearing compounds not indicated by the doctor test.

Volatility

The production of a straight run crude gasoline having a specified boiling point range is a problem in the control of the tower stills which are in general use in

the California section. It is of interest to note that a typical straight run gasoline from crude produced in the Whittier-Fullerton district had the following distillation test:

Start	125° F.
20%	226
50%	284
90%	388
Dry	437

The vapor pressure of this gasoline, was found to be 136 mm of mercury at 60 degrees F. The yields of gasoline and their boiling ranges, produced from several California crudes are given in the following table:

Origin—	Whittier	North Midway	Elk Hills	Ventura	Midway
A. P. I. Gravity of Crude	25.9	16.0	24.3	29.3	17.5
Per Cent Sediment	1.0	4.6	.3	1.0	.4
Per Cent Gasoline in Crude	23.4	1.5	12.9	29.5	18.4
A. P. I. Gravity of Gasoline	...	52.8	49.5	52.6	52.5
A. S. T. M. Analyses of Gasoline: °F.—					
Start	125	...	175	126	131
20%	226	...	237	212	220
50%	284	...	269	272	260
90%	388	...	331	380	323
Dry	437	...	381	435	366

One of the largest of the California producers and refiners uses the following standards for summer and winter grade gasoline:

A. S. T. M. Analyses of Gasoline, Per Cent	Summer Grade	Winter Grade
Start	Less than 131°F.	Less than 110°F.
20	" " 221	" " 215
50	" " 284	" " 284
90	" " 392	" " 374
Dry	" " 437	" " 437

Methods of Treating

The operation of applying chemical treatment may be considered under two headings; batch treatment and continuous treatment. Batch treatment is the system well known to all in the oil industry and is commonly carried out in lead lined agitators of various sizes. Intimate contact of the gasoline and the treating agents is secured by either injecting compressed air into the bottom of the batch, or the use of a certifulgal pump arranged so as to take suction on the bottom of the agitator and discharge oil and reagent back into the top of the agitator. In the latter case a well closed agitator may be used to prevent as much as possible the escape of volatile constituents of the gasoline. While practically all types of reagents may be applied by means of some form of batch operation not all processes have been worked out in continuous systems. Some of the most important methods of treatment depending on the use of various reagents are listed as follows:

1. Sulfuric Acid Treatment, Water Wash, Caustic Soda Treatment, Water Wash. (66 degrees sulfuric acid is usually employed for California straight run gasolines.)
2. No. 1 treatment followed by Doctor Treatment.
3. Doctor Treatment, Acid Treatment, Water Wash, Doctor Treatment. (This is sometimes known as a split plumbite treatment.)
4. Hypochlorite Treatment.
5. Silica Gel Treatment.

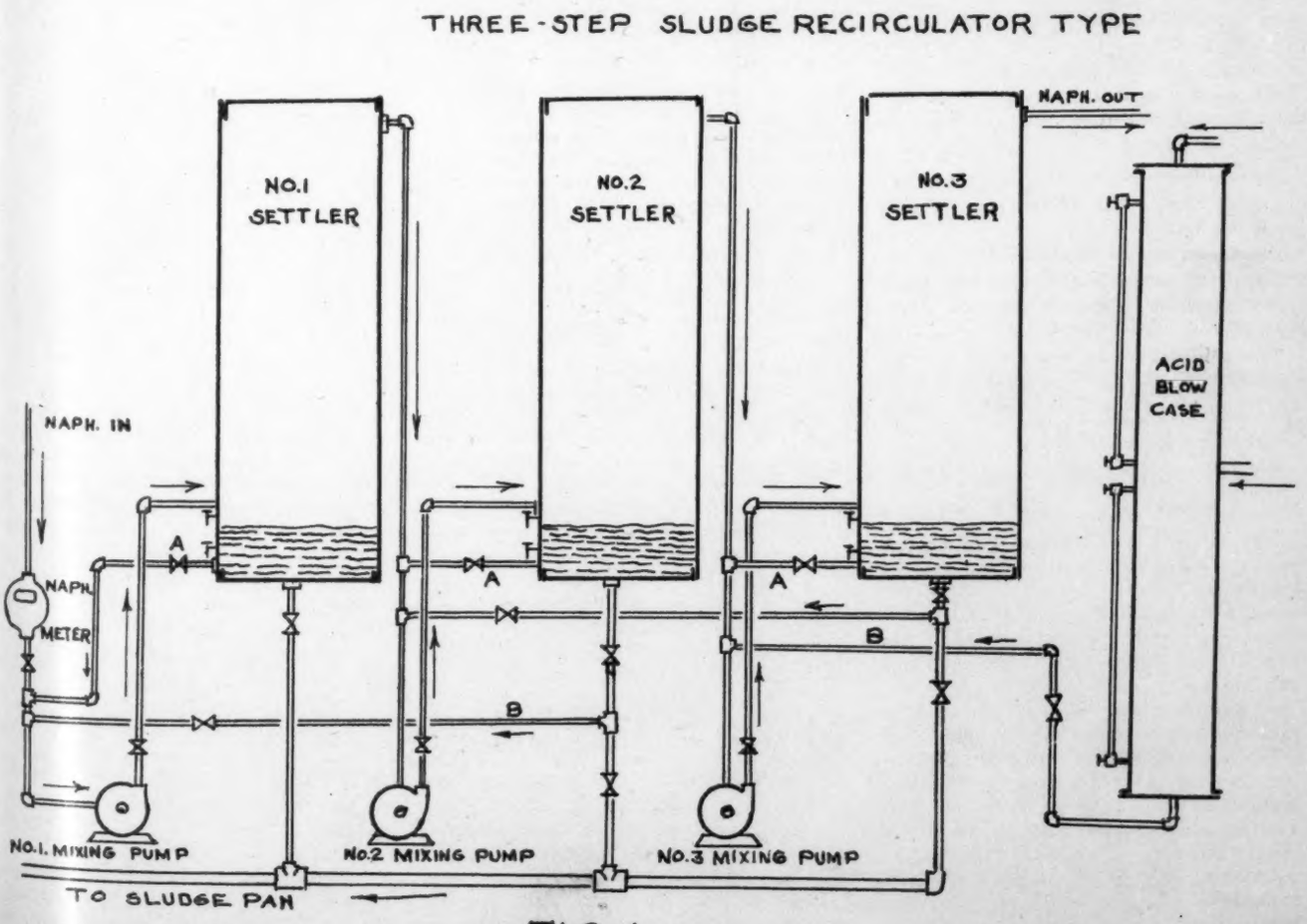


FIG. 1.

6. Single Doctor Treatment.
7. Copper Treatment.
8. Copper Oxide Treatment.
9. Aluminum Chloride Treatment.
10. Contact Clay Treatment.
11. Acid Treatment followed by Clay Treatment.

With the large number of chemicals available for use in various process it would appear that the choice of the most economical procedure would be made with considerable difficulty. In the discussion of methods of treating it should be remembered that the choice of the proper method depends on a large number of factors, some of which are:

1. Specifications which the finished gasoline must meet.

2. Properties of the crude gasoline to be treated.

3. Type of equipment available for use (i.e. batch agitators, continuous system, etc.)

4. Cost of reagents, depreciation of equipment, cost of labor.

Taking all of these factors into consideration some of the California refiners have concluded that the use of a closed system making use of sulfuric acid as the chief refining agent is the most economical. In some cases continuous plants have been in operation for over five years and plans for rebuilding are under way.

Batch Treatment of Straight Run Gasoline

This process is fast becoming antiquated, the more progressive refiners adopting some form of continuous treating plant. Into the lead lined, cone bottom agitator is pumped 12,000 gallons of crude gasoline from the tower stills. This stock has the following properties:

Color—9 Saybolt.

Doctor Test—Positive.

Copper Strip Test (3 hrs. at 170 degrees F.) Bad corrosion.

Per Cent Sulfur—.07.

The gravity, boiling range, and yield from crude of various California fields have already been given.

The composition of the crude gasoline may be given approximately as follows:

Aromatic hydrocarbons	4.%
Unsaturated hydrocarbons (unidentified)	5
Paraffins	58
Naphthenes	33

The sulfuric acid used in this case is 66 degree Be. black acid obtained by retorting acid sludge to obtain a realtive weak acid and building it up to a strength of 66 degrees Be. by the addition of the required quantity of 15 per cent fuming sulfuric acid.

About 200 pounds of acid sludge from previous treatments is then pumped into the agitator and circulated with the gasoline through a centrifugal pump taking suction on the bottom of the cone of the agitator and discharging gasoline and sludge through a network of pipes fitted with many small nozzles back into the main body of gasoline. The purpose of this preliminary treatment of the gasoline with acid sludge is the removal of small quantities of water which if allowed to remain in the system when the strong acid is mixed with the gasoline would cause considerable increase in temperature with consequent oxidation and polymerization of the oil. The circulation of the acid and oil is continued for only about ten minutes when the agitator pump is shut off, the sludge allowed to settle for a similar length of time and is then carefully drawn off to the acid sludge pans.

One thousand pounds of the 66 degree black sulfuric acid is then discharged from the "acid blow case" by means of compressed air, into the agitator. Agitation is then carried on by means of the centrifugal pump as in the case of the "drying acid treatment" but for a period of one hour. The batch is then allowed to stand for from one to two hours and the acid sludge drawn off. About a liter of the acid treated gasoline is then neutralized with weak caustic soda and washed with water in a separatory funnel, by hand. The gasoline is then poured through a filter paper into a four ounce bottle in order that its color may be inspected.

If the acid treatment has been sufficient to produce gasoline of satisfactory color the treatment is concluded by agitation with four per cent by volume of 5 degree Be. Caustic Soda Solution.

If the gasoline still has a slightly pink coloration it is treated with about 20 per cent by volume of fresh or salt water. If the coloration persists the water wash should be repeated. In cases where the original acid treatment has not been sufficient to produce satisfactory color as shown by the test an additional 500 pounds of acid should be added as a second separate treatment or "dose" as it is isfactory quality in regard to its color stability may be produced by this process it is sometimes found desirable to produce a product passing rigid corrosion tests. A process which has been found to be successful for this purpose is the Copper Treatment.

Copper Treatment

Gasoline having satisfactory characteristics but not passing the corrosion tests is treated as follows. An agitator or some form of acid resisting treating tower is packed with iron turnings, iron or steel wool, etc., to about three fourths of its capacity. If this material is obtained from local machine shops it should be carefully washed with clean naphtha to remove cutting oil from the turnings and other materials which would cause contamination of the gasoline. After being properly cleaned a ten per cent solution of copper sulfate is pumped onto the iron packing and allowed to stand overnight. Due to the fact that copper stands below iron in the Electromotive Force Series of Metals it will be replaced in the solution by iron and copper will be deposited, thus:

$$Fe+CuSO_4=FeSO_4+Cu.$$

This freshly depisited copper has been found to be very active in the removal of free sulfur dissolved in the gasoline, hydrogen sulfide, and possibly organic sulfides, thiophenes or other sulfur bearing compounds which cause the formation of copper sulfide or complex copper—sulfur compounds in the corrosion tests. After standing in contact with the iron turnings the spent copper sulfate solution is drawn off and returned to the storage provided for it. The gasoline to be treated is then pumped in and allowed to stand in contact with the active copper material for a variable length of time, depending on the characteristics of the gasoline being treated and the exact tests to be met. In most cases a period of eight hours is sufficient although for some gasolines twelve or fourteen hours are required.

The gasoline is then drawn or pumped off from the treating vessel, which completes its treatment. After the copper "sponge" has been allowed to stand in contact with the gasoline several times it becomes coated with sulfide. The copper is then recovered by treating the packing material with dilute sulfuric acid, the copper sulfide reacting with the acid to form hydrogen sulfide and copper sulfate which may be used again in the process.

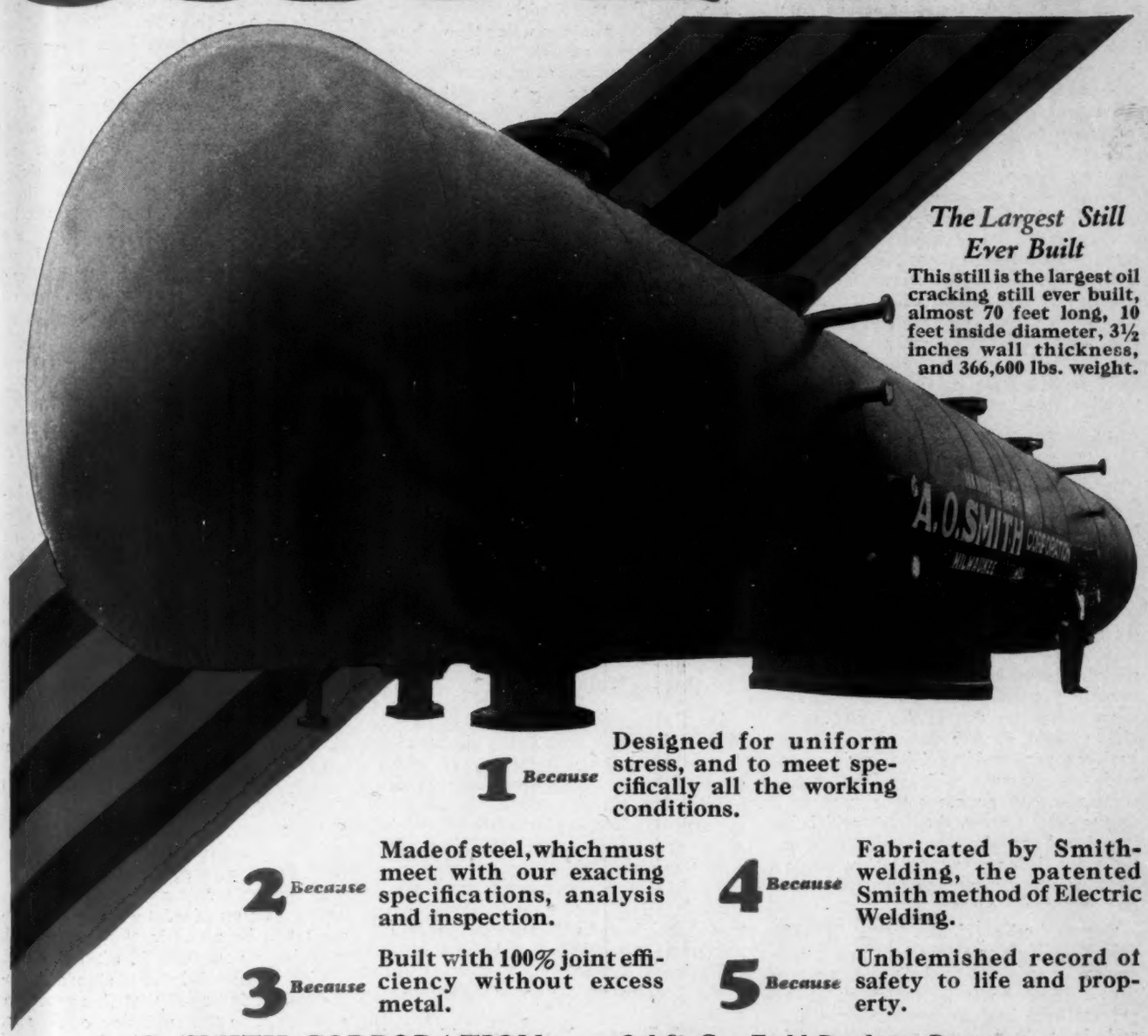
Ammonia Process

Another process being made use of by the California refiners is the use of ammonia in the run-down lines. During the distillation of the crude considerable hydrogen sulfide is evolved and in some cases this is reduced to elementary sulfur while in the pipe lines leading from the fractionating towers. In carrying out the procedure a cylinder of liquid ammonia is connected by means of a quarter inch pipe to the vapor line of the crude still. While carrying out the distillation process a small stream of the ammonia gas is allowed to flow into the run down line. Any hydrogen sulfide in the vapor line ultimately reacts with the ammonia and the small amount of water required in the reaction to form ammonium sulfide which is readily soluble in water which may be present in the run down lines. It is of interest that ammonium sulfide solution also has the property of dissolving an appreciable quantity of sulfur with the formation of polysulfide. By this treatment not only is the hydrogen sulfide removed but the formation of free sulfur is also prevented. The use of ammonia aids to a very appreciable extent in the production of crude gasolines which is more easily handled in the refining process being described. Another advantageous feature which more than pays for the installation of the equipment required for the application of the ammonia is the reduction of the corrosion of the pipe lines and other equipment.

Continuous Treatment of Straight Run Gasoline

In *The* REFINER AND NATURAL GASOLINE MANUFACTURER, Vol 6, No. 5, pp. 51-52, (1927) the writer has briefly described two systems of treatment of pressure naphtha by a continuous process; the system used for treating the naphtha at normal temperatures is also adaptable to the refining of gasoline. For the naphtha treatment with lye pretreatment, acid treatment, water wash, neutralization with lye and final water wash, from eight to ten closed treaters and settling tanks, are usually required. For the treatment of

SAFETY



The Largest Still Ever Built

This still is the largest oil cracking still ever built, almost 70 feet long, 10 feet inside diameter, 3½ inches wall thickness, and 366,600 lbs. weight.

1 Because Designed for uniform stress, and to meet specifically all the working conditions.

2 Because Made of steel, which must meet with our exacting specifications, analysis and inspection.

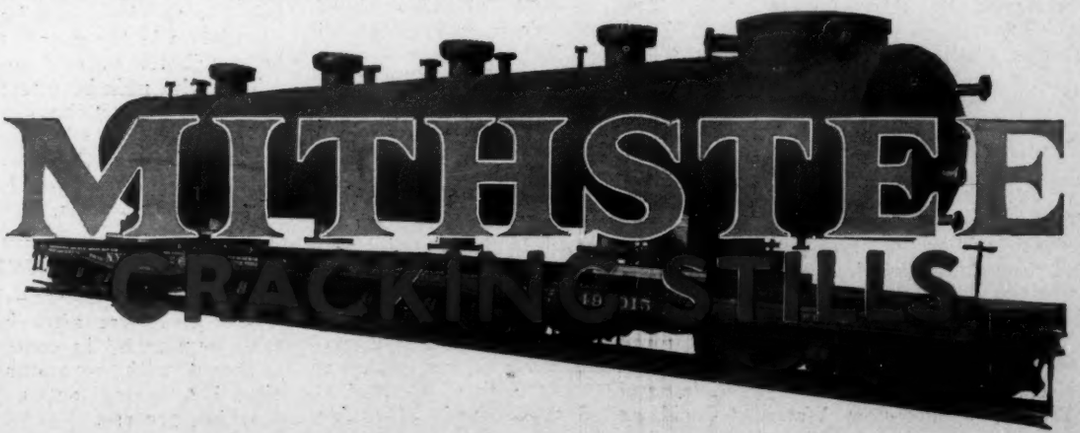
3 Because Built with 100% joint efficiency without excess metal.

4 Because Fabricated by Smith-welding, the patented Smith method of Electric Welding.

5 Because Unblemished record of safety to life and property.

A. O. SMITH CORPORATION
General Offices—Milwaukee, Wisconsin

Oil & Gas Field Products Division
District Offices at New York, Pittsburgh, Tulsa, Houston, Los Angeles



SMITHSTEEL CRACKING STILLS

gasoline at least half of these treaters may be dispensed with. Discarded tank cars, reaction vessels from cracking plants, various sized storage tanks, etc., may be lined with lead and utilized in a continuous treating plant. While in practically all of the older installations the treaters were mounted in a vertical position, it can not be denied that for those units in which the reagents are to be settled from the gasoline the treaters should be placed in a horizontal position. In this position they will offer their maximum cross sectional area to the flow of the oil which of course means a minimum velocity which is conducive to the most efficient settling. However it should be remembered that the first continuous treating plants were more or less of an experiment and it was not always known how many treaters and settlers would be required. In most of these continuous treating plants changes in the method of operation are quite frequently made, and the vertical arrangement of the treaters is most adaptable to these changes. The operation of the continuous treaters may be classified as con-flow, counter-flow and various combinations of these two.

Counter-Flow Treatment of Straight Run Gasoline

By the term counter-flow, is meant the flow of the acid or other reagent used, and the gasoline in opposite directions. W. C. Laird (U. S. Patent, 1,320,396, Nov. 4, 1919) treats oil in a counter-flow apparatus consisting of trays containing the acid over which the oil may flow in a counter flow direction. The oil and acid also pass from tray to tray in an enclosed column, in a counterflow direction. It is very probable that such an apparatus is unsatisfactory due to the fact that the oil and acid do not come into intimate surface relationship. The writer has made experiments with a fractionating column of the Lummus type used as a counter-flow treater, the fresh acid being introduced near the top of the column and the sludge being drawn out at the bottom. Very poor treatment was obtained due to lack of proper contact.

Eugene Leslie (U. S. Patent 1,310,164, July 15, 1919) passes the acid in a counter-flow direction through the oil in a vertical cylindrical vessel. Variations of this process have been in use for some time, and have been very successful. The scheme used by one California refiner making use of ten vertical tanks about eight feet in diameter by thirty feet in height is as follows:

No. 1. Treater, Settler for entrained water.

No. 2. Treater, Settler for entrained water.

No. 3. Treater, Oil passed through a three foot layer of weak acid to remove final traces of water.

No. 4. Treater, one-quarter pound of 66 degree Sulfuric acid per gallon of gasoline, sprayed through two nozzles at the top of the treater.

No. 5. Treater, Settler.

No. 6. Treater, 50 per cent by volume of salt water introduced into the pipe line connecting No. 5 and No. 6.

No. 7. Treater, Counter-flow Water Washer, 50 per cent by volume of salt water.

No. 8. Treater, Counter-flow Treater, four per cent 5 degree Be. Caustic Soda. Re-circulated seven times and drawn off to sewer.

No. 9. Treater, Counter-flow Water Washer, 50 per cent by volume of salt water.

No. 10. Treater, Settler.

Pumping the crude gasoline through the system at a rate of 200 barrels per hour and using the quantities of chemicals just noted, a gasoline having a Saybolt Color of 17 was produced. By increasing the number of nozzles (jet diameter ⅛-inch) from two to ten, and mixing with the acid a quantity of crude acid from the bottom of No. 3 Treater, which was forced to the nozzles by means of a special pump, gasoline of No. 20 color was produced. A pressure of from 40 to 50 pounds was maintained on the nozzles. Batch treatment on this same gasoline utilizing only .20 pounds of acid per gallon produces satisfactory color of 25 Saybolt. Experiments made with a counter-flow treater varying in height from ten to thirty feet showed very little difference in the quality of gasoline produced at different heights in the treating column. Due to the fact that the acid sludge produced in such counter-flow treatments is still capable of producing gasoline of satisfactory color as shown by tests on a small scale, it is believed that while the counter-flow principle is correct in theory, in practice it does not appear to be possible from a mechanical standpoint to produce a sufficiently intimate contact of the acid with the gasoline.

Con-Flow Treatment

Dr. C. M. Alexander (U. S. Patent 1,402,733, Jan. 10, 1922) has invented a process of con-flow treatment in which the oil and acid are mechanically agitated as they flow through a conduit, the temperature of which can be controlled. While it is not known to the author that con-flow treaters of this type are in use in California, there are several plants operating in which use is made of the con-flow principle in baffle lines and centrifugal pumps. One refiner makes use of the following system:

No. 1 Treater, Settler for entrained water.

No. 2 Treater, Treatment with weak acid for final removal of water.

No. 3 Treater, Pipe line connecting top of No. 2 and bottom of No. 3 is equipped with 16 pairs of plates, each perforated with 18 ½-inch holes. One tenth of a pound of acid per gallon of gasoline treated is continuously forced from the acid blow case into the suction side of a large centrifugal pump discharging through the baffle line just described into the bottom of No. 3 which serves as a sludge settler. The suction side of the pump is connected to the top of No. 2 from which the gasoline is drawn, and also to the bottom of No. 3 from which acid sludge is drawn, thus the liquid passing through the pump consists of a mixture in the proportion of one gallon of crude gasoline, one tenth of a pound of 66 acid, and 3 to 5 pounds of sludge. Spent sludge is drawn continuously from the bottom of No. 3 to the sludge pan.

No. 4 to 8 Treaters, are used about the same as listed under Counter-flow treatment, for the final treatment of the gasoline.

By this treatment, gasoline of 25 color is produced by the use of one tenth of a pound of acid per gallon of gasoline treated. Rates as high as 300 to 400 barrels of gasoline per hour have been successfully handled. This equipment is known as the sludge recirculator type of treater and may also be elaborated to two and even three stages of recirculation. It is of interest that in using the recirculator idea in two or more steps that the acid sludge progresses from stage to stage in a counter-flow direction to the gasoline being treated. This equipment has also been found to be satisfactory for the refining of pressure naphthas. The acid treating section of a three-step sludge recirculator type of treater is shown in the figure.

Adopt Standard Test for Gasoline Content of Gas

At the regular monthly meeting of the California Natural Gasoline Association, held in Los Angeles, California, on March 14, 1928, the "Tentative Standard Pressure Charcoal Test for Natural Gas Gasoline Content" was adopted by a vote of the membership.

The standard as adopted is the outcome of the work which has been carried on by the Gas Testing Committee of the association during the past several months, and represents a summing up of the best current practice in the determination of the gasoline content of natural gas by the manufacturers of natural gasoline in California.

It is believed by all concerned that this standard test will be fair to both the producer and the manufacturer, and its use is recommended in connection with all royalty settlement tests.

If, as the result of the adoption and use of this standard test, any improvement can be made in the test method, such improvement will, after due trial, be incorporated in the standard procedure. It is hoped that this procedure will result in the evolution of the most practical test in the minimum space of time.

The standard as adopted will be published in the form of a bulletin by the association in the near future, and will be distributed or sold to members or others who may be interested. When available for distribution, copies may be obtained by communicating with the secretary of the association, Paul D. Barton, 701 South Palm Avenue, Alhambra, California.

FATALLY BURNED

El Dorado, Arkansas.—Dr. A. J. Edwards died here after being sprayed with flaming oil in conducting an experiment with apparatus he had designed to carry out a vapor phase cracking process.

Crack and Flash

If a high grade crude oil yielding 50% gasoline from skimming were available it would command a high premium, probably a prohibitive one and the gasoline would likely be a bad knocker

The Dubbs Process with Flashing System yields 50% or more premium gasoline from gas oil or topped crude About 47% is accounted for as distillate and premium fuel oil The remaining 3% is gas for operating the process and a very small amount of coke

The Flashing System with the Dubbs Process has made this possible

Universal Oil Products Co
Chicago, Illinois

Dubbs Cracking Process
Owner and Licensor

NEW EQUIPMENT, CATALOGS, BULLETINS, BOOKS

Leak Sealing Equipment

FURMANITE CORPORATION

The Furmanite Corporation, Newport News, Virginia, has developed and is now marketing leak-sealing equipment and compound recommended for stopping leaks in piping and pressure machinery while full pressure remains on the piping.

The compound, Furmanite, is put in cartridge form to be used with the Furmanite leak-sealing equipment. The compound is so composed that when it is first heated it can be forced into the leak under high pressure by means of suitable pressure guns, but it quickly vulcanizes under the continued application of heat so that a permanent repair can be quickly made. It is a packing compound, and when hardened by vulcanization, possesses the properties of a packing. The material is particularly suitable for sealing leaks in steam, fresh water, salt water and compressed air lines. It is claimed that when the substance vulcanizes it is forced into the minute pores of the metal flanges, by the high injection pressure.

The Furmanite leak-sealing equipment consists of the required pressure guns, fittings and other tools required for the injection of the compound into the leak. It also includes baffles, clamps, holders and devices necessary for confining the sealing compound in the leak while vulcanization is taking place. The equipment contains sufficient tools to seal practically every leak which may break out in the bolted joints in any plant, it is claimed.

Briefly stated, the operation of sealing a leak consists of forcing the Furmanite compound by means of the guns into the leak under a greater pressure than the pressure of the gas or fluid inside the pipe or container, and confining the semi-fluid compound in the leak by means of baffles, clamps and other suitable appliances, until it hardens. After vucanization or hardening has taken place, which occurs in approximately 15 minutes, appliances and equipment are then removed from the joint or leaking section, nothing being left on or in the pipe or container except the compound.

The standard Furmanite compound and the tools are for sealing leaking joints and blow holes in pipe lines, cylinders, tanks, etc. There are many fields of application, for instance, sealing leaks in the gaskets of cylinder heads of engines, pumps, compressors, bolted connections on tanks. The standard equipment is designed for standard companion flanges, valves and fittings up to 24-inches in size and for extra heavy companion flanges, valves and fittings up to 18-inch pipe size in plain faced flanges, raised face flanges, male and female flanges, tongue and groove flanges, and Van Stone or lapped pipe joint.

Special equipment is made for larger sizes of pipe.

Further information may be secured from the manufacturers by request.

Sealing a leak in a Van Stone Joint.

New Refractories

A. P. GREEN FIREBRICK COMPANY

The A. P. Green Firebrick Company, Mexico, Missouri, is putting on the market two new refractories under the trade names of "Kruzite" and "Mizzou."

Kruzite is a Diaspore brick manufactured from high-alumina material and is especially recommended for heavy service conditions such as in the metallurgy of non-ferrous metals and in boiler settings.

Mizzou is also a high-alumina Diaspore brick, but designed for a different purpose from Kruzite. It is an open-texture, porous refractory having high resistance to heat and is desirable for fluctuating temperatures and heavy loads. This refractory is suitable for use in oil-fired furnaces operating at high ratings, boiler settings, etc.

More information on both refractories can be secured from the company, by request.

Improved Instrument

BROWN INSTRUMENT COMPANY

The Brown Instrument Company, Philadelphia, Pennsylvania, announces that it is now able to furnish the Brown Continuous Strip Chart instruments in cases of the flush type.

A new feature of the flush type enables the operator to take the recording mechanism out of the case at the front any time it becomes necessary to inspect the apparatus.

Brown recording pyrometers and carbon dioxide meters, tachometers and resistance thermometers can also be furnished in flush type cases with or without panels as specified. All of these instruments can be supplied in single, duplex, multiple or multiple duplex models capable of producing from one to 12 records on one chart.

Additional information is available from the company by request.

Bulletin Announcement

"Stopping Evaporation and Fire," is a new booklet which has just been issued by the Chicago Bridge and Iron Works, Chicago. The bulletin deals principally with the Wiggins Floating Roof, and numerous reports on evaporation are given. There are also other tables and fire tests. The booklet is illustrated with new pictures, and has a large cutaway drawing on the center spread. There is a flow chart which indicates the type of roof recommended for each general class of tanks. Copies of the booklet are distributed free of charge by the company.

RECORDING WATT METERS

The Bristol Company, Waterbury, Connecticut, has released catalog No. 1502 which describes Bristol Recording Wattmeters and Recording Frequency Meters. Copies of the catalog are available upon request to the company.

A CONTRIBUTION to Aeronautical Science

Flight . . . man's realization . . . the Wright brothers pushed out of their bicycle shop the first heavier than air machine.

It flew.

Flight . . . man's pursuit . . . hazardous . . . discouraging . . . the clumsy flounderings of the fledgling . . . now up, now down, struggling and striving for power, for safety . . . speed . . . endurance.

Then War birds . . . dashing daring sacrifice . . . not in vain, but for the advance of science . . . the triumph of aviation.

Came peace . . . pinions of progress . . oceans spanned . . . worlds united.

Now! The era of flying with altimeters, speed indicators, direction finders . . . what next? . . . Fuel . . . the occult power that makes it all possible.

Flying has reached the efficiency, the economy stage.

It has taken unto itself a valuable auxiliary in Naturaline, the super fuel embodying the important and obvious advantages of *quick starting, fast pick up, increased revolutions per minute* (from 50 to 125) *greater speed, 20 to 25% more power.*

High volatility without gas lock, complete combustion and complete burning even at low temperatures, does not freeze at high altitudes and WEIGHS 46 POUNDS PER 100 GALLONS LESS THAN U. S. DOMESTIC AVIATION FUEL.

This characteristic alone gives to the user of Naturaline the great advantages of increased efficiency, more pay-load, less strain, longer flight, an important factor when the margin of profit in commercial flying is squeezed down in the wine press of intense competition . . . an even more important factor *now* when commercial air ways are being subsidized to get them on a paying basis.

Naturaline was evolved and perfected in our laboratories, tested and tried through scientific and exhaustive research, then proven . . . proven in the motors of planes, piloted by men qualified to judge . . . proven in thousands of miles of actual flying . . . a deserving contribution to the advance of Aeronautical science, a deserving auxiliary that keeps the plane aloft with greater power to lift, power to carry, power to endure, with power and affinity to climb higher and higher.

CHESTNUT & SMITH CORPORATION

CHESTNUT & SMITH BUILDING

Tulsa Okla.

Cable Address: NATURALINE

Acid-Sludge Problem in Oil Refining*

By J. B. RATHER
Standard Oil Company of New York

THE use of sulphuric acid in refining illuminating oils antedates the beginning of the petroleum industry in America by many years. It was used as early as 1792 by Tower in refining "coal oil" in the British Isles, and by 1860 there were 53 refineries in the United States manufacturing "coal oil," most of them using sulphuric acid as a refining agent. Following the completion of the Drake well in 1859, many of the "coal oil" refiners began to use petroleum for manufacturing illuminating oil, and their methods and equipment were adapted so far as possible to this new raw material. The value of sulphuric acid in refining "coal oil" having been established, this reagent was immediately tried and found to be satisfactory in refining petroleum. Notwithstanding the tremendous advances in petroleum technology since that time, sulphuric acid remains today the most valuable and most widely used means for refining petroleum products.

Early Methods of Disposal of Acid Sludge

With the almost immediate expansion of the petroleum industry came the problem of disposing of the acid sludge produced in the refining operations. While in 1859, the year of the discovery of the Drake well, a patent was granted for sludge separation and separated acid concentration, most of the earlier refiners, and many of their successors, felt that separation and recovery of spent acid was uneconomical. Accordingly, many of them disposed of the sludge in any way that seemed expedient at the time. It was buried in the refinery grounds, barged and dumped at sea, run into neighboring streams, or dumped into sewers. Some optimists carted it to open pits in the hope that it would either sink into the ground or evaporate. Not so many years ago, the superintendent of an eastern refinery, who was using the open-pit method of disposal, lost a sludge cart, with horse attached, in such a pit. The horse was recovered almost immediately, but its availability for further use was reduced to zero by the loss of its hair.

Those of us who are familiar with subsurface conditions in the older refineries know that excavations for foundations for refinery structures are very likely to lead to the discovery of a long-forgotten sludge deposit.

At a western plant, where the amount of acid sludge was not large, for a time it was disposed of by dumping into city sewers. The success of this method was more apparent than real, for the city authorities, noticing unusual conditions, traced the difficulty to the refinery. Everyone was able to take cover except the refinery foreman, who had to explain his action in court, and later to meditate in jail for a short time.

Another simple method of disposing of acid sludge used by an eastern refinery some 30 years ago, consisted in the erection of a 500 barrel tank on a dock located on a navigable stream, with a draw-off pipe running through the dock into the water beneath. During the day the sludge was pumped into the tank and at night, just before leaving, the chief oil treater would open the valve leading to the water beneath the tank. The next morning the tank was empty and the cycle was begun all over again. This practise was followed for a number of years until it became evident that other means of disposal would have to be adopted. Even then it was felt that the ocean was the best place for sludge and it was barged out to sea and dumped.

Another refiner pumped his sludge to a sump located on a hillside. The level of sludge in the sump remained constant and the problem of disposal was regarded as solved. A few months later is was found, however, that much of the acid was finding its way to a lake in a neighboring valley, and another method of sludge disposal had to be found.

It is interesting to compare these early methods of sludge disposal, which were frequently based on an entire disregard for the rights of the community, with the modern practice, especially as regards water pollution on the Atlantic seabord. At one refinery, where all waste waters were discharged through a private sewer into a bay, samples of the water were taken direct from the sewer at 30 minute intervals for a period of several years. These samples were analyzed for acidity on the spot, and the acid concentration was kept, by dilution to a very few parts per milliion. At this refinery, and a number of others in the same section of the country, the waters adjacent to the plants are constantly patroled, and any oil or tar, whther resulting from sludge or otherwise is skimmed off the surface of the water by hand. Elaborate and highly efficient trap systems have been developed and the precautions taken today to prevent pollution in a number of localities would be beyond the comprehension of the refiner of an earlier generation.

Development of Separation Process

It is interesting to note that in the same year as the Drake discovery (1859), a patent (U. S. 24952) was granted to Henry Pemberton for a method of treating acid suldge. While this patent applied principally to sludge of bituminous origin, reference was also made to acid sludge from petroleum distillates. The proposed process consisted of:

1. A preliminary heating to obtain a separation of the free sour oil.
2. Agitation of the acid-sludge residue with hot water and open steam.
3. Separation of weak acid and tar.
4. The recovery of acid by evaporation of the weak acid in lead pans.

The patent is particularly significant inasmuch as the process formed the basis for a majority of the later patents. The Pemberton patent was followed by somewhat similar ones by Loftus in 1864, by Penissant in 1878 and by Farrar and Gill in the same year. These three patents form the foundation on which all modern practice of acid separation and recovery is based. Since that time many patents have been issued, a few of which are mentioned below, but practically all of them utilize the basic procedure of diluting with water, agitating and settling.

Bower, in 1880, recovered sulphuric acid by washing the sludge with water in covered tanks and mechanically separating the acid solution from the carbonaceous matter and the oily ingredients. Breinig, in 1884, mixed with the sludge a soap compound adapted to unite with the tar, and separated the free acid from the tarry mass. J. L. Gray, in 1909, claimed the production of pitch and asphalt from petroleum sludge by digestion with water, steam, or dilute acid recovered from the sludge, until the major portion of the acid had been recovered. The tar, comparatively free from acid, was heated with a steam spray until the mass was converted into pitch. Another of Gray's patents covered a process in which the acid sludge was digested with water, air, and steam, until the light constituents rose to the top. These were drawn off, and the digestion continued until a second grade had arisen. A heavy residuum was drawn off from the bottom of the

*Paper read before the American Institute of Mining and Mettalurgical Engineers, New York Meeting, 1928. Copyright, 1928.

separator, and the weak acid finally separated.

Schildhaus and Condra, in 1910, heated acid sludge to 200 degrees to 300 degrees C. and at the same time introduced air into the retort at about the same temperature. The liquid hydrocarbons were distilled and condensed, and the gases, consisting largely of sulphur dioxide, were washed first with heavy hydrocarbon oil and finally with sulphuric acid. No better means of producing sulphur dioxide from the materials at hand could have been thought of.

Van Tienen, in 1911, appears to have been among the earlier inventors making use of both heat and pressure for sludge separation. He recovered hydrocarbons and sulphuric acid from sludge by mixing sufficient water with it to dilute the acid to 52 degrees Be., and heating the mixture to a temperature of 140 degrees to 165 degrees C. at a pressure of about 100 pounds per square inch. The liquid was separated into two layers, one containing sulfuric acid and the other containing tar.

A type of separation for sludges from so-called "paraffine" lubricating oils, largely used in the past, and still the most desirable under certain conditions, consists in cooking the sludge, without dilution with water, with open steam in a cone-bottom, dome-top lead-lined agitator, equipped with a scrubbing device for taking care of the sulfur dioxide and other vapors evolved. The cooking is carried on for several hours, after which the batch is allowed to settle into three layers, acid of about 54 degrees Be., pitch and acid oil. The acid and acid-oil layers are drawn off and the pitch layer is fed to a screw conveyor, where it is subjected to a spray of cold salt or fresh water. This operation transforms the pitch into coke-like particles of about ½ to 1 inch diameter, which can be handled and burned under boilers or stills like coal.

This method has not proved altogether satisfactory, on account of the difficulty of transporting the acid coke or pitch and to the corrosive action on equipment when burning. The more recent installation of specially designed fireboxes and burning equipment has increased efficiencies in this connection.

An alternative practiced in some refineries consists in the neutralization of the acid coke with alkali after separation of the weak acid. The product in this case is liquid, pumpable, and may be burned to advantage in the usual fuel-oil equipment. It is sometimes necessary, however, to add gas oil before burning, to lighten the consistency.

Forms of Separators

The first form of separator was nothing more than a tank provided with means of agitation and suitable connections for withdrawing the acid and oil. This type of separator was adequate as long as gasoline and kerosene from paraffine-base crudes were the only products. The light character of sludges from these sources made the separation problem a simple one. It was soon found, however, that simple agitation with water would not serve to separate lubricating-oil sludges and accordingly open steam pipes were introduced into the separators. With other types of sludges, notably those obtained from fuming acid treats of napthene-base kerosene distillates, it became necessary to cook many hours with steam under a pressure of several atmospheres.

All of these types of separators were intermittent, or "batch," separators. Continuous separators are a more recent development. Heckenbleikner, in 1926, patented a separator consisting of a "closed pressure container, having an exterior acid-proof lining and an interior refractory facing for the lining." Suitable lines and tanks necessary for accomplishing the continuous separation of the acid sludge and its constituents are provided. An eastern refiner uses a simple device for separating in a continuous manner the sludges obtained from 66 degree acid treatment of gasoline and kerosene distillates. This separator operates without external heat and without pressure. It delivers a separated acid of constant gravity and requires practically no attention.

Separators may be of almost any size, from 50 to 500 barrels capacity, depending on the amount and nature of the sludge available and on whether or not the separated sludge is to be fluxed in the separator. A typical batch separator for light-oil sludge consists of a lead-lined, cone-bottom and cone- or dome-roofed tank, equipped with water and air lines and sludge intake and draw-off connections. Frequently it has means of scrubbing the air as it goes out of the separator, in order to remove the sulfur dioxide which is invariably evolved in considerable quantities.

Separators for certain types of Pacific Coast light-oil sludges are practically autoclaves capable of withstanding a pressure of 100 pounds per square inch or more, in which the sludge is cooked with water and steam for several hours.

Where light-oil and lubricating-oil sludges are available in the same plant, they are frequently combined before the acid-separation process, and the resulting mixture of pitch and acid oil is fluxed with heavy fuel oil. In general, separators for this purpose are of conventional design, as described above.

Development of Acid Concentrators

Many of the earlier refineries had sludge-acid separation plants but were not equipped for acid concentration. The separated acid was sold to other refiners equipped to concentrate acid, or to manufacturers of acid phosphate intended for fertilizer, or disposed of by dilution with sea water, where that was available.

Concentration methods were given attention by inventors at an early date. Both Loftus, in 1864, and Penissant, in 1878, described methods for concentrating separated acid. Gronsilliers, in 1888, added sodium sulfate to the separated acid and the bisulfate was precipitated by boiling and evaporating. The precipitate was dried and the acid recovered by heating at a moderate red heat. Waring and Breckenridge mixed about 4 per cent of sodium nitrate with sludge acid at a temperature between 60 degrees and 180 degrees F., to purify it and permit the recovery of the sulfuric acid. A foreign patent of interest is that of the Steaua Romana Petroleum G. M. b. H., in which the separated black acid was allowed to flow continuously into pure, boiling, concentrated sulfuric acid in the presence of an oxidizing current of air, the evolved acid vapors then being condensed and reconcentrated in standard apparatus.

The common American practice in sludge-acid concentrations up to about 1920 consisted in concentrating to 60 degrees Be. in lead pans, and finishing to 66 degrees Be. in cast-iron pans or glass retorts. The lead concentrating pans commonly employed varied considerably in size in the different plants. According to Day, units 5 feet wide by 50 feet long and 10 inches deep, as well as a series of shorter pans of the same width (15 to 20 feet long) were not uncommon. Such pans were generally constructed of 10-pound chemical lead, and supported by perforated, cast-iron plates laid over the furnace flues. Heat for concentration was frequently supplied by combustion of the separated acid oil.

The acid left the last compartment of the pan, or the last pan of the series at about 60 degrees to 62 degrees Be. and passed to a series of two cast-iron pans, or "stills," generally about 4 by 8 feet by 10 inches deep, provided with hoods lined with acid-resisting materials, leaving the end pan at a temperature of about 450 degrees F. and a gravity of about 66 degrees Be. The vapors were usually condensed in a scrubber and the weak acid returned to the system. The lift of these castings was very short, averaging in one western plant about six weeks, and failure of the pans frequently resulted in the loss of appreciable percentages of acid.

Increased efficiency in operating pan plants was said to be obtainable by bubbling air through the acid, and by cascade systems of fused silica basins. However, while a "pan and still" plant was built on the west coast at late as 1920, and while many such plants are no doubt still in use, the trend in the last seven years has been away from such methods of concentration.

In a number of refineries, particularly in the East, the final concentration of the acid was conducted in glass retorts or "bottles," holding about 750 pounds of 62 degree Be. acid. This type of installation also delivered acid of 66 degree Be. strength. When the bottles

(Continued on page 102)

CLARK "SUPER 2"

Combines Lowest Operating Cost with ⅓ Less Fuel Cost~

The CLARK "Super 2" Compressor has won immediate and wide-spread recognition because it combines 2-cycle simplicity and operating economy with *fuel economy fully equal to that of a 4-cycle plant.*

Simply and powerfully designed, with few parts to demand attention and adjustment, the "Super 2" requires a smaller operating force than a 4-cycle installation.

The unprecedented fuel economy is attributable to our new, patented FUEL INJECTOR, which acts as a real super-charger, furnishing to the cylinder, after it is filled with air, the correct amount of gas under pressure. Because better mixing of air and gas is obtained, with no loss of gas into the exhaust, the "Super 2" operates on 1/3 *less gas* than the best 2-cycle engine with the usual suction type feed.

"Super 2" Compressors are now demonstrating their dependability and economy in a multitude of plants. The photograph shows CLARK "Super 2" Twin Compressors in the engine room of Roeser & Pendleton, Inc., and Marland Refining Company Gasoline Plant No. 1, at Shackelford, Texas.

CLARK BROS. COMPANY
Olean, N. Y.

Branch and Warehouse: 125 W. First St., Tulsa
Warehouses at McCamey and Sweetwater, Tex., and Artesia, N. M.
SMITH BOOTH USHER COMPANY
228 S. Central Ave., Los Angeles. 50 Fremont St., San Francisco

CLARK

Mention Where You Saw the Advertisement

Technological Control of Refinery Processes

By ERNEST B. PHILLIPS[1] AND ALBERT E. MILLER[2]

Part One

THE title assigned to this paper permits a discussion of one of the most interesting chapters in the history of the American Petroleum Industry. Nature was kind to man when she prepared crude oil for him in commercial quantities in the hills of Northwestern Pennsylvania. Most of the refining operations we are now accustomed to apply were either not needed or had been carried out by earth processes ages ago. Such technology as was applied dealt with the physical separation of the valuable components in the crude oil and intermediate products and did not need more than mild refining treatments to bring them to marketable quality.

The pioneer refiners were concerned principally with distilling, dewaxing and decolorizing operations. The products produced were limited in number and the uses to which they could be put were few. Natural products from the very high grade crudes, then plentiful, supplied the domestic demand, and no other markets were open. As time passed, other producing fields were discovered and crude oils of lower natural quality were made available. To refine these grades to a quality expected by buyers, refinery practice had to be changed and new methods found. At the same time the accidental discovery that crude residues could be cracked by dry distillation at atmospheric pressure to produce a much larger amount of lamp oil than had been customary, opened a new vista for the industry. Export kerosene soon became the leading revenue product for all refiners and considerable new technic was added to refinery practice. High sulphur crude oils from Ohio next made their appearance, causing the development of the first commercial desulphurizing process, the sodium plumbite treating method for "sour" lamp oil stocks and the application of fine earth for the removal of "flock." Some improvements in methods of handling lubricating oils and cylinder stock fractions of crude were worked out, but, in general, it can be said that the closing decade of the last century found the industry in a stabilized condition.

Typical refinery operations of 1900 were simple and were conducted with the single purpose of producing as much export kerosene as possible. Light naphthas and fuel oils were a drug on the market and every means was taken to hold the yields of these commodities to the lowest possible figures. Crudes were run for test bottoms, the overhead being cut for crude naphtha over to 52 degrees, water white stock 52 degrees to 42 degrees, prime white stock 42 degrees to 38 degrees, gas oil 38 degrees to 32 degrees, wax distillate 32 degrees down to the desired residue, with steam refined stock, flux or coke as the still residue. Intermediate stocks were all steam-stilled for such light naphthas as were wanted and the steam still bottoms were included in the prime white stock. The water white stock was steam-stilled to test and distillate fractions sent back to crude naphtha for redistillation. The prime white stock, plus the naphtha bottoms, was steamstilled to test and the almost worthless distillate, known as gas naphtha, was lost in the best possible way, usually by running it down some convenient river. Gas oil was sold as such and lubricating oil stocks were finished in ways suitable for producing engine oils and cylinder stocks.

Such laboratory control of quality of products as was carried out in the early days was confined to pure physical testing of commercial products. Lamp oils received the most attention and lubricating oils somewhat less. The laboratory staffs were headed by men from the refinery organizations and testers were recruited from the neighborhood. These men were trained simply to know whether a product met current specifications or not, and at that point their responsibilities ended. No thought was given to yields and no equipment was supplied for determining whether quality could be made better. In fact, the laboratory staff was usually regarded as a nuisance by operating department. Practically no attention was paid to the cost of producing certain products and very ilttle accurate accounting was carried out.

With the turn of the century, however, developments within the petroleum industry came rapidly. The prolific Texas and Mid-Continent fields poured forth their floods of oil and ways had to be devised for handling these crudes possessed of entirely different characteristics from those which had hitherto been the only crudes available. Plants in operation in 1900 were in no shape to run the heavy oil from the Spindletop field. A new equipment had to be created before suitable refineries could be built. For the first time in the history of the American Petroleum industry the laboratory staffs were called upon to furnish data from which refinery units could be designed. This resulted in the construction of experimental laboratories and in the installation of semicommercial equipment. How well these first experimental plants fulfilled their destiny can be seen in the records of the older Gulf Coast refineries. Such operations as reruns over lye and acid treating test lubricating oil distillates to obtain finished products do not seem unusual to us now, but they marked distinct advances when first practiced. During this same period, 1905 to 1910, the first pipe lines from Oklahoma to the Gulf were being laid and mixed paraffin base crudes were being delivered to refineries in large quantities. These oils were not considered fit for the production of lubricating oil and were to a large extent only skimmed to produce light oils and the residue sold as fuel oils. The controlling factor in the world markets was still the production of export kerosene and all operations had to be planned with that fact in view. Gasolines, naphthas and fuel oils were by-products and could never be made of primary importance.

The above gives a very good picture of the condition of the American oil industry up to about 1912 or shortly before the outbreak of the world war. Practically every oil refinery in the country had been built on designs sanctioned by long use. Almost over night, export kerosene was dethroned as the world's most important petroleum product and the hitherto practically worthless naphthas became the sources of greatest revenue. The industry was faced with the necessity of executing an "about-face" in the system of handling crude oil. Whereas,

---

[1]Chief Chemist, Sinclair Refining Company, East Chicago, Indiana.

[2]Process Chemist, Sinclair Refining Company, 45 Nassau Street, New York. Paper read before the American Institute of Mining and Metallurgical Engineers, New York Meeting, 1928.
Copyright by the American Institute of Mining and Metallurgical Engineers, Inc., 1928.

before, good management had consisted of squeezing into export kerosene every drop of distillate possible, the new conditions demanded the maximum production of motor fuel.

From 1910 to the close of the war, little change in refinery equipment or operations was witnessed, but a new force was beginning to make itself felt. Wise managers had begun to fill their laboratory and engineering staffs with young technically trained men. These men brought with them a new viewpoint into the industry. They were chemists and engineers who were unhampered by the traditions of the industry and who were loath to believe anything was being done in the best manner or at the least cost possible. The newcomers did not receive a cordial welcome from the old time operators, nor were they allowed at first to have much to say about refinery operations. Instead, experimental laboratories were built for them and they were told to produce results on a semi-commercial scale. History testifies how well these men did their work. The basic ideas underlying all of our present day practices were conceived in that period and each individual process was worked out on a semi-commercial scale before a single plant unit was designed. Such developments brought to the attention of refinery managers the vital importance of technical control of refinery operations and paved the way for the era of expansion which followed the war years.

At the end of the war many refinery plants in this country were in poor physical condition and the equipment in service was not suited for the class of work that a modern refinery had to do. During the boom years following, new and modern construction was the order of the day. The executive heads of many of the old companies realizing this, were willing to give over the active running of the oil industry to younger men of the new school but still maintained such a connection that their valuable experience and direction were still available.

New types of refining units were coming on the scene, and these units were in the hands of the new generation. Engineers and chemists were at hand who had received all of their training under the new conditions. The combination of these forces has made possible the great strides in refinery technology which we have witnessed in the last ten years.

Just as the manufacture of lamp oil (prime white kerosene) had given impetus to the industry in the 19th century, the production of synthetic motor fuels furnished the inspiration in the 20th. This time, however, the industry found itself with greater resources both in men and equipment than had been the case in the earlier period. Technically trained men had gained experience in refinery practice from semi-commercial development work and were in position to build and operate complicated refinery units. The systems of operating on a laboratory scale where a close control of operations was maintained were bodily applied to the refinery when commercial units were put in operation. So much depended on positive control both from the standpoints of safety and yield that no refinery manager could be content with the old style methods of operating. Success in special fields such as pressure cracking drew attention to the desirability of placing all refinery operations under similar control. The result has been that no modern refinery can stay in the game unless every operation is watched by a competent technical staff. So far as actual contact with refinery operations goes, the technical staff functions as an auditor, whose units of measure are yields and quality instead of dollars and cents.

Modern Methods of Technological Control

Having traced in a general way the progress of technical operations in refineries from early times, we can now pass to the consideration of a full scale techincal staff suitable for a modern refinery. The chief executive officer of a company expects from his technical staff information along four definite lines which may be expressed as follows:

First, he wishes to know whether or not his present equipment and methods of operating are yielding products of full quality and in the amounts actually present in his charging stocks.

Second, whether the individual operations in his plant are being carried out in the quickest, cheapest and most efficient manner.

Third, whether new processes, apparatus or products offered him by outsiders have real merit and should be investigated, and

Fourth, it must be possible for him to have available the patent history of every process he is using or is being developed in his organization, as well as the same information for any piece of apparatus now in operation or which may be contemplated, or of any product which he is now producing or intends to produce.

In order that these four prime requisites may be taken care of, the technical staff may be divided into two main groups, one of which will deal with all matters relating to actual or proposed refinery practice, and the other with the outside investigations and patent searches.

As a center for operations of the above mentioned staff, a general laboratory should be provided equipped with all modern apparatus and having a personnel of competent oil inspectors and chemists. This group is charged with responsibility for the quality of all materials or products bought or sold by the company. Besides this routine work, men with special training should be available for detail work in any field in which the company may have an interest. The chief functions of this unit are to keep close watch on the quality of all raw and finished products in the refinery and to furnish analytical data on materials from all sources. Of almost equal importance is the manner of routine examination of competitive products and the recognition of all points of merit displayed by them.

Application of Small Scale Work-ups For Controlling Current Refinery Operations

An essential factor in the scheme of technical control proposed above is the provision of an experimental plant. In it, small scale units designed to operate as nearly like refinery counterparts as possible are fitted up so that any desired operation met with in the refinery itself may be carried out but on a much smaller scale. Samples ranging from one to 50 gallons in quantity may be required for these operations. Such an experimental plant had best be housed in a separate building designed to reduce fire hazards to a minimum. To this experimental plant are sent all samples of crude and intermediate products from which yields of commercial finished products are desired. Various kinds of distillations, chemical treatment and filtration tests make up a large part of the work performed. The staff must consist of experienced stillmen and treaters who have had long contact with small scale work. They are charged specifically with determining potential yields of products from all actual or proposed refinery stocks. It is from these units that the basic data for the technical control of refinery operations is obtained.

The value of the class of work outlined in the above paragraph can best be illustrated by giving typical examples of method used in controlling certain major operations. As is well known, all producing companies in active fields maintain field scouts whose duty it is to collect samples of crude from every new pool discovered and forward them to the central laboratory. These samples are subjected to routine inspection for the purpose of classifying them and then they are worked up according to the refinery method which would be applied. Inspection reports on field crudes are prepared, types of which are shown below:

Typical Work-ups Covering Different Kinds of Crude Oils on Small Experimental Scale

A.—Crude from Appalachian Fields

I.—Tests on Crude

Gravity	41.2
Flash	RT
Pour	0
BS	0.2%
Sulphur	0.12%
Color	Amber

500 cc. Distillation

Over 10%	154° F.	
20	253	68.4 gr.
30	320	59.3
40	392	52.2
50	472	47.1
% at 221	547	42.7
284		5.4%
392		14.9
420		30.0
440		31.5
		34.0

II.—Tower Distillation of Crude

Charge 100% Crude Cut	Grade	% Crude	Gravity 41.2 Gravity
Over to 46.7	400 End Distillate	35.0%	59.1
Over to 45.4	420 End Distillate	38.0	57.9
Over to 44.4	437 End Distillate	41.0	56.8
Over to 43.4	450 End Distillate	43.0	56.2
Bottoms	Reduced Crude	55.6	32.2
Loss		1.4	
		100.0%	

Tests on Products

Grade	400 End	420 End	437 End	450 End	Reduced Crude
Gravity	59.1	57.9	56.8	56.8	32.2
Over	124	126	127	130	500
10%	184	166	191	194	
20	212	218	225	226	
30	234	241	250	252	
40	255	266	274	277	
50	276	287	298	307	
60	296	310	322	333	
70	315	336	353	360	
80	339	359	378	390	
90	364	386	406	419	
End	399	420	437	450	
% at 221	24.0	21.5	18.5	18.0	
284	54.0	49.0	44.5	42.5	
392	...	92.0	85.0	81.0	

The yields of kerosene, fuel oil, wax distillate and cylinder stock from this crude are so well known that further working of reduced crude is not necessary.

B.—Crude from Mid-Continent Fields

I.—Tests on Crude

Gravity	35.0
Flash	RT
BS	0.3%
Sulphur	0.39%
Color	Dark Green

500 cc. Distillation

Over 10%	136°F.	
20	194	75.2 gr
30	326	60.0
40	409	51.0
50	503	43.3
50% Bottoms	602	37.6
		23.2

II.—Towerstilling Crude

Charge 100% Crude Cut	Grade	% Crude	Gravity 35.0 Gravity
Over to 43.7	400 End Distillate	29.0%	59.3
43.7 to 40.5	41° Kerosene	12.0	41.7
Over to 41.9	91/392 Goods	33.0%	57.3
41.9 to 40.9	41° Kerosene	5.0	41.6
Over to 41.0	450 End Distillate	36.0%	55.0
Bottoms	Reduced Crude	62.5	26.0
Loss		1.5	
		100.0%	

1.—Tests on Products

Gasolines

Grade	400 End	91/392 Goods	450 End	7% Casinghead 93% 91/392 Goods
Gravity	59.3	57.3	55.0	58.8
Over	130	135	140	113
10%	169	180	188	168
20	206	212	221	202
30	230	237	250	231
40	254	264	274	252
50	276	288	304	281
60	298	312	332	312
70	314	338	358	338
80	333	365	384	365
90	359	390	418	390
End	399	430	452	430
% at 221	26.0	23.0	20.0	27.0
284	54.0	48.0	43.0	51.0
392	...	91.0	83.0	91.0

Kerosenes

After making	400 End	91/392 Goods
Gravity	41.7	41.6
Flash TCC	120	120
Viscosity	460	465
Initial	380	394
10%	400	418
20	425	435
30	434	442
40	440	446
50	448	450
60	452	454
70	457	457
80	464	462
90	478	470
End	496	488

C.—Gulf Coast Crude

I.—Tests on Crude

Gravity	21.6
Flash	195
Fire	235
BS	0.2%
Pour	0
Sulphur	0.35%

(Continued on page 94)

II.—Distilling Crude

Charge 100% Crude Cut	Grade	% Crude	Gravity 21.6 Gravity
Over to 26	Gas Oil	29.0%	29.6
26 to off	Lub Distillate	59.6	20.7
Bottoms	Flux	10.3	12.1
Loss		1.1	
		100.0%	

III.—Rerunning Lub Distillate Over Lye

Charge 59.6% Crude Cut	Grade	% Charge	% Crude	Gravity 20.7 Gravity
Distillate	Lub Stock	94.0%	56.0%	21.0
Bottoms	Caustic Fuel	5.0	3.0	9.0
Loss		1.0	0.6	
		100.0%	59.6%	

IV.—Reducing Lub Stock for Test Bottoms

In order to work up lub stock from Section III, a pre-determined ratio of production of different grades must be adopted. This is usually taken as average of plant production over a period of time. The breakup desired in this particular case is 1.7 parts 750 stock, 12.8 parts 500 stock, 17 parts 300 stock and 1.7 parts 200 stock. On the above basis the lub stock produced under Section III will show

1.7% of the crude stock was set aside as 750 stock and remainder of distillate and bottoms mixed for new charging stock,

"500 stock" equivalent to 12.8% of crude was set aside for this grade and distillate mixed back with the residue.

1.—Reducing for 750 Stock

Charge 56.0% Crude Cut	Grade	% Charge	% Crude	Gravity 21.0 Gravity
Distillate	Lub Stock	45.0%	25.2%	23.4
Bottoms	750 Stock	54.0	30.2	18.8
Loss		1.0	0.6	
		100.0%	56.0%	

2.—Reducing for 500 Stock

Charge 53.7% Crude Cut	Grade	% Charge	% Crude	Gravity 21.1 Gravity
Distillate	Lub Stock	35.0%	18.79%	24.2
Bottoms	500 Stock	64.0	34.37	19.0
Loss		1.0	0.54	
		100.0%	53.70%	

3.—Reducing for 300 Vis. Stock

Charge 40.37% Crude Cut	Grade	% Charge	% Crude	Gravity 21.6 Gravity
Distillate	Lub Stock	30.0%	12.11%	25.4
Bottoms	300 Stock	69.0	27.86	20.2
Loss		1.0	0.40	
		100.0%	40.37%	

300 vis. stock equivalent to 17.04% of crude was held out and balance mixed with distillate fraction.

200 vis. stock equivalent to 1.7% of crude was set aside for this grade and balance mixed with distillate.

4.—Reducing for 200 Vis. Stock

Charge 22.93% Crude Cut	Grade	% Charge	% Crude	Gravity 22.7 Gravity
Distillate	Lub Stock	40.0%	9.17%	26.4
Bottoms	200 Stock	59.0	13.53	20.5
Loss		1.0	0.23	
		100.0%	22.93%	

5.—Reducing for 100 Vis. Stock

Charge 21.0% Crude Cut	Grade	% Charge	% Crude	Gravity 22.9 Gravity
Distillate	Gas Oil	19.6%	4.12%	27.2
Bottoms	100 Vis. Stock	79.4	16.67	21.4
Loss		1.0	0.21	
		100.0%	21.00%	

Tests on Products

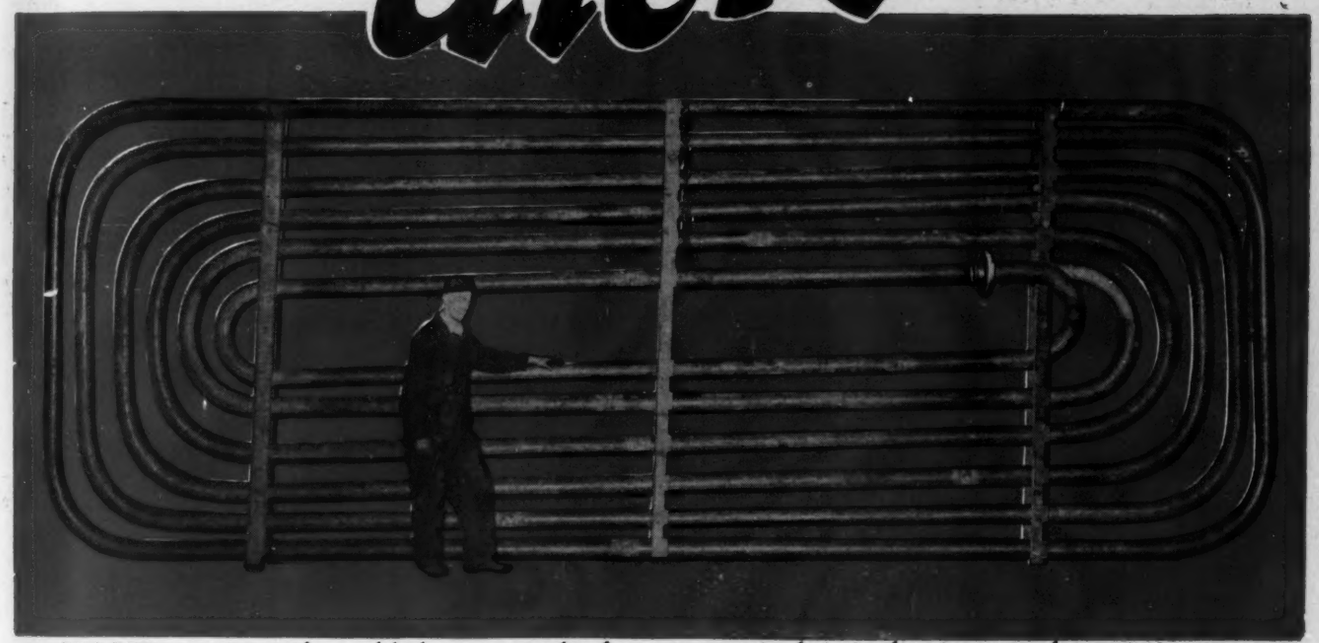
Grade	750 Stock	500 Stock	300 Stock	200 Stock	100 Stock
Gravity	18.8	19.0	20.2	20.5	21.4
Flash	385	365	335	315	280
Fire	445	425	380	360	315
Vis. at 100	768	522	314	213	110
Pour	5	0	0	0	0

Summary of Products

Grade	% Crude	Gravity	Grade	% Crude	Gravity
Natural Gas Oil	29.00	29.6	500 Vis. Stock	12.79	19.0
Cracked Gas Oil	4.12	27.2	750 Vis. Stock	1.70	18.8
100 Vis. Stock	16.67	21.4	Fuel	13.30	11.1
200 Vis. Stock	1.70	20.5	Losses	3.68	
300 Vis. Stock	17.04	20.2		100.00%	

(Continued on page 96)

habitually *alert*



THE continuously welded pressure distillate condenser coil shown here is an excellent example of this Midwest characteristic—habitual alertness to better serve the users of fabricated piping. Previous to the time that Midwest began fabricating these coils, they were assembled from straight lengths of pipe, flanges and cast return bends.

The benefits of the improved design resulting from Midwest alertness are:

Elimination of 142 joints, which required 142 aluminum gaskets, 142 sets of studs and 75 cast return bends.

Large reduction in cost.

10% more condensing surface in same size box.

Reduced maintenance cost.

Greater structural strength.

Decreased erection cost and time.

Probably you also can profit from the use of this Midwest piping service. Get in touch with the office nearest you when you have a piping problem or require fabricated piping.

MIDWEST PIPING & SUPPLY COMPANY

Plants at Los Angeles and St. Louis

Offices:	Los Angeles	Tulsa	St. Louis	Chicago
	520 Anderson St.	805 Mayo Bldg.	1450 S. Second St.	208 S. LaSalle St.

MIDWEST Piping Service

Mention Where You Saw the Advertisement

With reports of the kind shown above refinery executives are able to keep fully informed on the quality of current new production and to pick, when possible, grades best suited for the plant. Over a period of years a file will be accumulated which includes type crude oils from all over the world and any new pool discovered can be placed with relation to all others.

Specimen Work-up Showing Effect of Application of Close Control on Small Scale to Current Refinery Operations

Next in importance to obtaining a knowledge of the possible products that can be obtained from any given crude, such as described above, comes the control of daily routine operations in the refinery. The superintendent in charge of operations has daily reports made up showing the quality of all raw and finished stocks on hand. These must of necessity be qualitative in nature and serve only to protect against sudden changes in crude supply or faulty operations in individual units of the plant. If, however, a "bogey sample," amounting to at least a barrel, representing an aliquot portion of each day's stock, is made up to cover a month's operation, materials will be at hand for independent work-ups of the stocks into the products which the refinery is supposed to be making. For this purpose bogey samples are needed consisting of (1) average crude, (2) average rerun naphtha, and (3) average process still charging stock, in case there is a special process, such as a cracking process, in the refinery. At the same time, a copy of the refinery yield statement and a composite of tests on all products made must be provided.

A form is then made up on which average tests for all products made by the refinery are shown. Bogey work-ups are then outlined to produce the same quality stocks as were made in the refinery. The final report shows refinery and bogey yields in parallel columns. Detailed descriptions of the apparatus used in this work would be of little value for the reason that each refining unit has its own special designs of equipment, which would have to be matched in experimental sized units. The importance of bogey barrel runs can best be shown by a type case. Let us assume that we have a typical refinery equipped with tower stills for crude and rerun operations, coke stills operating on reduced crude and process still capacity to handle all available cracking stock. The materials charged to the various stills might show:

Crude to Stills	100.00%
Cracking Stock to Stills	126.71
Pressure Still Tar to Stills	1.47
Total to Stills	228.18%

Let us assume that the operations in the refinery required the production of five grades of gasoline and naphtha which might be produced in the following amounts:

64-66 Gasoline	1.62%
60-62 Gasoline	1.60
USM Gasoline	47.28
437 End Gasoline	9.91
450 End Naphtha	8.35

The individual operations in the bogey workup should be reported as follows:

A.—Quality of Crude

I.—Tests on Charging Crude

Gravity		35.5
Flash		RT
Pour		20
BS		0.3%
Sulphur		0.36%
Over	137°F.	
10%	247	72.0 gr.
20	316	59.6
30	385	51.4
40	469	44.6
50	555	38.8
50% Bottoms		22.8

II.—Towerstilling Crude

Charge 100% Crude Cut	Grade	% Crude	Gravity 35.5 Gravity
Over to 43.1	400 End Distillates	35.0%	58.3
Over to 41.8	91/392 Goods	38.0	57.0
Over to 40.3	437 End Distillate	41.0	55.9
Over to 39.9	450 End Distillate	43.0	54.9
Bottoms	Reduced Crude	55.5	24.9
Loss		1.5	
		100.0%	

1.—Tests on Products

Grade	400 End	91/392 Goods	437 End	450 End	Bottoms
Gravity	58.3	57.0	55.9	54.9	24.9
Initial	123	124	124	126	
10%	176	176	182	184	
20	208	209	216	218	
30	231	235	246	250	
40	252	257	266	274	
50	276	282	294	304	
60	294	312	321	332	
70	316	335	351	366	
80	340	358	362	392	
90E	368	390	414	451	
End	400	420	438		
% at 221	25.5	24.5	24.0	21.5	
284	55.0	51.0	47.0	44.0	
392	...	90.5	84.0	80.0	

The purpose of the above breakup is to provide accurate data on quality of crude being charged from month to month. It is, of course, apparent that no refinery could operate commercially and turn out a single grade of gasoline like any of those shown. Sales Department demands are varied and many grades must be manufactured. Runs for grades of gasoline specified in the foregoing paragraph are made as follows:

1.—Towerstilling Crude

Charge 100% Crude Cut	Grade	% Crude	Gravity 35.5 Gravity
Over to 47.8	60-62 Distillate	27.00%	61.6
60-62 grade finished		1.60	61.6
		25.40	
47.8 to 42.2	Gasoline Distillate	10.00	
USM Gasoline Finished		35.40	57.5
42.2 to 40.2	W. W. Distillate	7.00	41.2
Bottoms	Reduced Crude	54.50	25.4
Loss		1.50	
		100.00%	

(Continued on page 98)

For Protection Against Sulphides

Chemical reactions greatly reduce the service life of equipment which is susceptible to their corrosive influences. A coating of lead, zinc, aluminum, tin, copper or whatever metal best resists the particular deteriorating action, sprayed on in molten condition by METALAYER, assures everlasting protection and maximum durability.

METALAYER "The Putting-on Tool" applies coatings of any commercial metal on any surface, and can be used either in the shop or in the field. Sprayed molten metal coatings can also be used for protection against high temperature, for increasing weight or dimension, filling in defects and building up worn pump rods, etc., or other undersized parts.

We install the complete metal coating system in your plant, ready for profitable operation on production of maintenance work.

Write for the METALAYER Book.

METALS COATING CO. of AMERICA

495-497 N. 3rd St., Philadelphia

PITTSBURGH BOSTON CHICAGO
LONDON HAMBURG BERLIN PRAGUE

ZINCŌTING with METALAYER

Mention Where You Saw the Advertisement

(Continued from page 96)

Tests on Products

Grade	60-62 Grade		USM Grade		W. W. Kerosene	
	Refinery	Bogey	Refinery	Bogey	Refinery	Bogey
Gravity	62.7	61.6	58.3	57.5	41.0	41.2
Initial	104	116	100	124	387	402
10%	152	167	165	180	415	424
20	182	192	205	208	426	434
30	208	210	233	233	432	438
40	227	227	258	256	438	441
50	244	243	280	278	444	444
60	260	260	304	304	451	447
70	277	279	330	328	460	449
80	300	294	356	354	471	454
90	328	323	386	387	490	459
End	389	364	426	419	536	479
% at 221	37.0	36.5	25.5	25.5 Fl.	148	90
284	73.0	73.0	51.5	52.0 Vis.	450	400
392	97.0	...	91.5	91.0		

II.—Reduced Crude and Pressure Tar to Coke

Charge 55.97% Crude — Gravity 25.2

Cut	Grade	% Charge	% Crude	Gravity
Distillate	PS Stock	94.35%	52.78%	31.8
Bottoms	Coke	5.2	2.91	
Loss		0.5	0.28	
		100.0%	55.97%	

III.—Skimming of PS Stock (Refinery Figures)

Charge 132.36% Crude — Gravity 31.0

	% Charge	% Crude	Gravity
Heavy Rerun Naphtha	4.27%	5.65%	52.6
PS Charging Stock	95.73	126.71	
	100.00%	132.36%	

IV.—Process Still Operation (Refinery Figures)

	% Crude	% Crude
PS Distillate	30.35%	38.46%
Gas Oil	54.22	68.70
PS Tar	1.16	1.47
PT Flux	11.70	14.83
Loss	2.57	3.25
	100.00%	126.71%

V.—Naphtha Rerun

Sources of Stock

	% Crude	Gravity
Heavy Naphtha	5.65%	52.6
PS Distillate	38.46	50.3
Total	44.11	50.4

Towerstilling Rerun Naphtha

Cut	Grade	% Charge	% Crude	Gravity
Over to 49.4	64-66 Gasoline	47.00%	20.73%	63.9
64-66 finished		3.67	1.62	63.9
		43.33	19.11	
49.4 to 41.1	Gasoline Stock	20.00	8.82	
US Motor made		63.33	27.93	
US Motor finished		26.93	11.88	
		35.40	16.05	
41.1 to 40.8	Gasoline Stock	2.00	0.88	
437 end made		37.40	16.93	
437 end finished		22.47	9.91	57.0
		15.93	7.02	
40.8 to 40.3	Gasoline Stock	4.00	1.76	
450 end finished		19.93	8.78	54.0
Bottoms		25.50	11.25	35.0
Loss		1.50	0.67	
		100.00%	44.11%	

Note—P S means pressure still; P T means pressure tar.

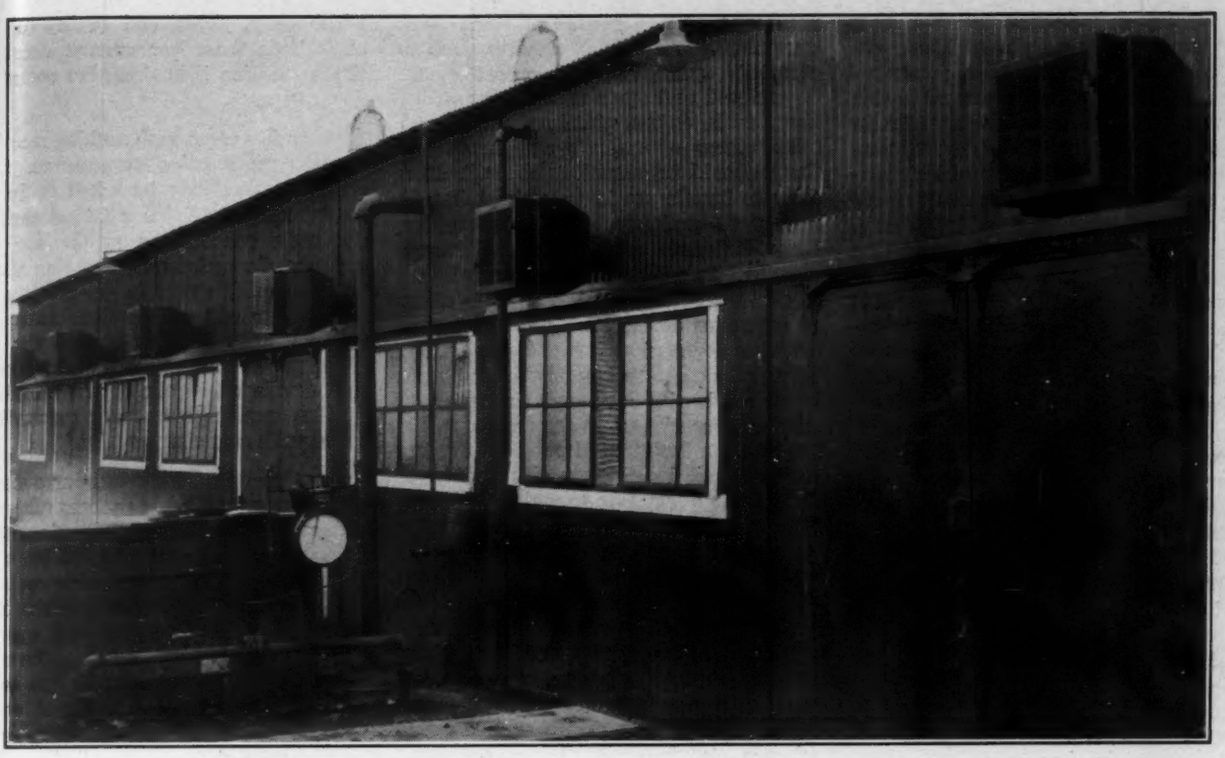
Tests on Products

Grade	64-66		U. S. Motor		437 End		450 End	
	Refinery	Bogey	Refinery	Bogey	Refinery	Bogey	Refinery	Bogey
Gravity	65.1	63.9	58.3	58.1	57.0	57.0	53.2	54.0
Initial	98	102	100	116	103	120	107	126
10%	144	154	165	176	172	178	183	192
20	168	171	205	210	213	216	231	234
30	200	199	233	236	243	246	269	268
40	219	218	258	262	269	268	304	297
50	236	235	280	282	293	288	333	322
60	249	248	304	302	319	312	353	343
70	264	262	330	319	343	330	383	363
80	280	276	356	334	368	348	403	378
90	309	290	386	357	399	366	420	391
End	365	320	428	378	433	342	442	406
% at 221	41.5	41.5	25.5	24.5	23.0	22.5	18.0	17.0
% at 284	81.5	86.5	51.5	51.0	47.0	48.0	34.5	35.0
% at 392	..	..	91.5	..	87.5	..	75.5	90.5

Summary of Products

Grade	Refinery		Bogey	
	% Crude	Gravity	% Crude	Gravity
64-66 Gasoline Distillate	1.62%	65.1	1.62%	63.9
60-62 Gasoline Distillate	1.60	62.7	1.60	61.6
U S M Gasoline Distillate	47.28	58.3	47.28	57.7
437 End Gasoline Distillate	991	57.0	9.91	57.0
450 End Naptha	8.35	53.2	8.78	54.0
W. W. Distillate	3.24	41.0	7.00	41.2
Furnace Oil	7.20		None	
Flux	11.47		14.83	
Miscellaneous	1.26		0.37	
Coke	3.87		2.91	
Loss	4.20		5.70	
	100.00%		100.00%	

(Continued on page 100)



Reed Filtered Air

SAVES WEAR AND TEAR ON ENGINES AND COMPRESSORS AT A LARGE PRODUCING COMPANY'S PLANT AT OXFORD, KANSAS.

85% to 95% of the so-called "carbon" which is deposited in internal combustion engines is nothing more or less than dust saturated with oil and baked in a hard mass. To avoid the formation of this dust carbon, which causes endless engine trouble, use Reed Air Filters to furnish pure, clean air at the intake ports—keep engines operating continuously with 100% efficiency.

Reed Air Filters are recommended by practically every manufacturer of engines and compressors in the United States, because a cleaning efficiency of from 97% to 99% is guaranteed, due to these Reed advantages:

(1) Low resistance,

(2) Large dust accumulating capacity,

(3) Easy maintenance, resulting in increased continuous efficiency of the unit.

Write for fully descriptive catalog

REED AIR FILTER CO., Inc., Louisville, Ky.

Distributed by:

SMITH SEPARATOR COMPANY

Tulsa *Okla.*

Reed Air

TRADE MARK

Above photos show installation of Reed Type SCF Air Filters at a Major Company's Oxford, Kansas, Plant, supplying *clean air* to a battery of compressors. Clean Air is as important a factor in the efficiency of any internal combustion engine as is the proper lubrication—that's why more and more large operators are specifying REED AIR for their operating units, even where dust conditions are not noticeably bad.

TEXAS OFFICES:
924 Post Dispatch Bldg., Houston, Texas

1402 Fort Worth Nat'l Bank Bldg., Fort Worth, Texas

LOUISIANA OFFICE:
737 Rutherford St., Shreveport, La.

CALIFORNIA OFFICE
2039 East 38th St., Los Angeles, Calif.

Mention Where You Saw the Advertisement

A careful examination of the type bogey barrel work-up shown above reveals the fact that a number of points require explanation. It was assumed in this case that all crude and rerun naphtha in the refinery were handled in continuous tower stills where the degree of fractionation commercially obtainable could never equal that of a laboratory batch unit, tower equipped, performing the same type of operation. For this reason the refinery products always show a wider boiling point range than the corresponding products from a laboratory batch still. This is seen quite plainly by studying the distillation tests throughout the workup. However, it so happens that when some intermediate point (per cent off at 221, 284 or 392 degrees F.) is taken as the control, the yields of products can be matched to a fraction of a per cent on the crude. Again, it must be borne in mind that refineries are obliged to produce certain intermediate products, such as furnace oil and the like, which contain potential motor fuel stocks. In judging the efficiency of refinery operations, low boiling point materials so diverted should be deducted from the bogey figures. In the type example, the furnace oil made contains enough light ends to account for the shortage of total gasoline production. The place where the refinery statement shows up short is, however, on the production of water white kerosene. This amounted in the above case to about four per cent or more on the crude.

A superintendent who has bogey barrel workups on his crude each month is in a position to select the units in the plant where yield is falling below expectations and from experience is able to judge whether additional recovery will pay. In the type case presented for your consideration, it is quite likely that the loss in through-put capacity suffered in attempts to obtain full yields of water white stock would cost more than would be compensated for in the value of the small increased percentage yield involved.

The details given on workups of crude oils and bogey samples from the refinery all deal with a single operation, namely, distillation. This is by far the most important single operation in a plant, but there are many others of only slightly less consequence. The nature of these secondary operations is such that good results can only be obtained when tests are conducted on a semi-commercial scale. Certain other activities of a technical staff call for test work under like conditions. so it will be convenient to discuss these matters under a separate head.

Application of Technical Control of Current Refinery Problems Carried Out on a Semi-Commercial Scale

The type of work we are now to consider has to do with checkups on refinery operations where full scale commercial operations have to be met with. For this purpose, a plot of ground at some point convenient to all refinery services, such as electricity, steam, air, and so forth, must be enclosed and space allotted for tanks, lines, stills, pumps, agitators, filters, and other pieces of refinery equipment. In these should be placed units built on a scale to handle stocks in carload lots, if necessary,—probably, on scales ranging from 20 barrels up to 100 or 200 barrels per day. In addition, ground must be set aside for the construction of new pieces of apparatus developed within the organization or offered to it by outside parties. The staff chosen to handle this unit must be selected with care and the top man must have special talent for the work. He has to know by instinct how to handle any problem and be able to pick merits or flaws in any operation to which he is giving his attention. In fact, to be a genuine success he must eat, drink and breathe petroleum. The personnel of his force should be made up largely of young technically trained men who have the ability to grasp the essential points in problems and the determination to make a thing work or else to find out the reason why it will not. The best slogan such a group of men can have is "Because a thing failed the hundredth time is no proof it will not work on the 200th attempt."

The work carried on in this plant has to do with study of routine refinery operations having for its purpose to find out whether the products made are of the best quality and whether or not costs are being held at the lowest figures possible. The important points to consider are through-put, efficiency of reactions where reagents are employed, and the good or bad quality of the final end products. In addition to this, the matter of corrosion, the wearing out of parts of equipment, the frequency of replacement, and other practical problems, should be borne in mind. This method of operating has a great advantage over full scale work for the reason that all steps in a given process are directly under the eye of the man in charge. He is able to detect weak spots that would not be observed by the refinery staff in routine operations. In this way ideas for improvements or for entirely new processes are conceived.

When a change in an old process is proposed or an entirely new method for doing a certain piece of work suggested, experimental apparatus is at once built to incorporate the new practice and put it in routine service. Months and even years of study must be devoted to the new unit before results of a satisfactory nature can be produced. The apparatus may have to be changed a dozen times in this period to meet all refinery conditions. Having passed this stage, the apparatus is fitted up just like a normal refinery unit of the class to which it belongs. It is then operated on a scale having a through-put of 100 to 200 barrels and all test data is secured based on regular refinery conditions. After a series of such runs in which costs, yields, and quality of products shade those for current operations, the proposition is in shape for commercial application.

When inventors with nothing more than paper patents offer propositions to the company, they may be asked to join the experimental staff for a period and work out their propositions at the company's expense, the understanding being that the inventors will share in the profits from any commercial use of their basic ideas. What usually happens is that the ideas, if good, are taken over by the company and developed by the experimental staff. In that case the inventor is generally satisfied with a modest royalty.

Another type of inventor may come to the company with his process all worked out. If the preliminary experiments give promise of real money value he will be asked to construct a semi-commercial unit at the experimental plant and instruct the regular force in its care and operation. It will be operated to produce the specific products which the refinery has to produce. In the vast majority of cases it will be found that the new process will not work on the stock supplied or else the costs are all out of proportion to the value of the products produced. Occasionally a good process is found and the chance that such a one will be overlooked makes it necessary to investigate them all.

The varied character of work done in such a plant calls for the exercise of a great deal of ingenuity in constructing apparatus. The idea is to have one typical piece of each kind of apparatus, likely to be required, in such shape that is can be incorporated in any arrangement of apparatus or process being studied. The basic operations dealt with are distillation, chemical treating, dewaxing and filtration, most of which have to be performed in a continuous manner. The first object is always to produce marketable specification products. Ways often have to be devised for small scale testing of products at various intermediate stages in a process and from these have been developed many of the newer types of refinery processes. Among these groups of activities belong such operations as mechanical stirring operations of the oils in place of the old air blowing system, contact filtration of oils with fine earth as opposed to the old percolation of oil through porous earth, the de-waxing by centrifuge or filter aids as against the older methods of cold settling or pressing, the reactivations of decolorizing medium in multi-hearth furances, such as are now widely used, instead of an internally fired rotary furnace, treatment of oils in the vapor phase with solid reagents in place of liquid phase treatment with liquid reagents. The details of methods and descriptions of apparatus used have no place in this paper for the reason they have no direct bearing on technical control.

(To be continued in May Issue)

Laid Here in 1892

Lifted Out 35 Years Later

Then Placed in Service Here

THE old U. S. Pipe Line just recently got through serving its apprenticeship in Pennsylvania. It was yanked out and shipped down to the Gulf coast to spend its maturity in a warmer region. Of course, it was wrought iron pipe. Every experienced oil man knows that pipe of any other material would have been retired decades ago.

Only wrought iron pipe will resist rust and corrosion so successfully. Simple enough, when you think of it—for wrought iron contains a natural element of slag which is impervious to rust. This slag is intermixed with the purified iron in such a way that it forms millions of barriers which rust must go *around* instead of *through*, as it does in steel.

Reading Pipe is the only wrought iron pipe double welded to increase its strength—its life and the value of your investment.

READING IRON COMPANY
READING, PA.

Houston Tulsa San Francisco Ft. Worth Los Angeles

READING PIPE
GENUINE WROUGHT IRON

Mention Where You Saw the Advertisement

Acid-Sludge Problem in Oil Refining
(Continued on page 89)

were carefully set and properly handled, the loss in breakage in a bottle plant was said to be small. However, the operation was intermittent or "batch," instead of being continuous, as was the case with the pan or "still" system, and the fuel cost was high. Furthermore, this method of final concentration was decidedly dangerous. There was no way adequately to test a "bottle" before it was put into service, and the failure of a bottle frequently resulted in dumping 700 pounds or more of concentrated acid at a high temperature on the floor of the bottle house. Refinery superintendents and foremen showed an entirely justifiable lack of interest in what was going on in the bottle house, and their inspections of operations frequently consisted in going in at one door of the house and out the other as rapidly as possible.

Systems of Concentration

The first plant on a semi-commercial scale for the continuous concentration of acid by bubbling hot flue gases through it was erected at Brooklyn in 1919, and the first fully commercial plant of this type was erected at Buffalo, N. Y., during the next year. This was followed by an installation at Providence, R. I., a short time later. Many such plants are scattered through the United States today.

This type of sludge-acid concentration is known as the Chemico process, and is based on the fact that when a mixture of hot air and flue gases is passed through the liquid to be concentrated, a substantially lower temperature may be carried than is required for pan concentration. In addition, heat transfer is better, and fuel costs correspondingly reduced. The total operating costs, including fuel, labor, general expenses and repairs, losses and royalty, is said to be fully 50 per cent lower than with the pan and still system.

Another system of sludge-acid concentration, known as the Simonson-Mantius process, is based on the principle of vacuum distillation, with its well-known advantages. The first plant of this type was erected at Paulsboro, N. J., several years ago, and a number of other plants of this kind have been put into operation since that time.

A more recent development is the Geyser system. This process resembles the Chemico process in that hot flue gases are used to supply the heat needed for evaporation of the water, but differs from it in that the evaporation is accomplished by blowing the flue gases across the surface of the liquid, which is kept in a violent state of ebullition by means of an independent stream of air.

The Chemico and Vacuum processes are two-stage systems, in which the first concentration is to 60 degrees to 62 degrees Be., and the final concentration to 66 degrees Be. The Geyser system is a one-stage process.

While great progress has undoubtedly been made in reducing the cost and nuisance of sludge-acid concentration, the nature of the material to be handled is such that this part of refinery operation still remains a troublesome and expensive procedure.

Disposal of Sludge by Burning

The solution of the sludge-disposal problem by burning the sludge has probably been attempted at one time or another by almost every refinery superintendent. Burning the sludge direct, without separation or fluxing, has been practiced to a certain extent. Burning after fluxing, without separation of acid, has also been tried. Burning after separation, either with or without fluxing, and burning the "coked" separated sludge, have been practiced for a long time.

At a large refinery on the Pacific Coast, it was formerly the practice to burn lubricating-oil sludges under boilers without any preparation whatever except separation of the loose acid. In order to facilitate combustion, the boiler furnaces were fitted with Dutch ovens, which reduced to a very considerable extent the tendency to throw unburned agglomerations of soft carbon out through the stacks. Of course, in such a system, all of the sulfuric acid in the sludge went out the stacks as acid or as sulfur dioxide and possibly trioxide, and it would not be possible to practice such a method of sludge disposal except in localities where the neighbors were few.

At one plant in the Mid-Continent field, partly neutralized sludge is mixed with about 20 degree A. P. I. fuel oil and burned in a specially designed burner with a vibrating valve stem. This type of sludge burning has been tried elsewhere and with varying success, depending on the nature of the sludge at hand.

The operation and maintenance of such systems as the above are both troublesome and expensive. Acid-resisting lines and pumps have to be provided, and even when the sludge is kept circulating all the time, line plugging is frequent.

Burning separated sludges from gasoline and kerosene treats from stock of Mid-Continent origin is relatively a simple matter. Such sludges are generally fluid enough to burn without fluxing, although there is frequently a certain amount of pitch-like material which cannot be pumped conveniently.

At one time, in an eastern refinery, sludges from the treatment of crude oil intended for cylinder stock were fluxed after the separation of the acid. Fluxing was done with heavy Mexican fuel oil with the aid of open steam in separators of about 500-barrel capacity. The fluxed sludge was then pumped about 1000 feet to a boiler house and burned. This system worked in a satisfactory manner as long as the sludge was separated and fluxed within 24 hours after it was produced. If allowed to "ripen" for several days before separation was attempted, it was almost impossible to secure adequate separation of acid or a satisfactory fluxed fuel.

The method of coking lubricating-oil sludges has been described above under methods of sludge separation. For types of sludge that respond to this treatment, this is probably the best way to handle the problem. This is largely due to the fact that sludges that may be coked readily are very difficult to flux, and vice versa.

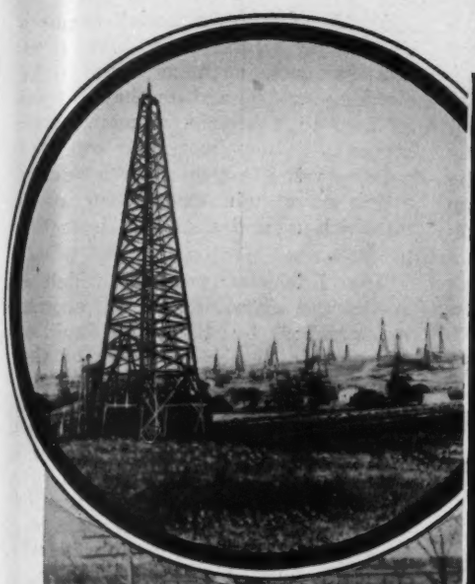
The proper method of disposal of sludges is very largely dependent on local conditions, and each refiner has a different problem to solve. We do not have, and probably never will have, a single method of sludge disposal that is applicable to all conditions.

The Fume Nuisance

Very early in the history of the petroleum industry, petroleum refineries were confronted with the fume-nuisance problem, and about 1958, Col. C. A. Ferris of New York was "forced to move his plant because his neighbors objected to strange and unsavory odors caused by the distillation and refining of oils." At the present time the disposal of sulfur dioxide and other fumes resulting from the separation and concentration of suldge acid is a problem of some magnitude. As early as 1880, E. Clark obtained a patent for a procedure for recovering spent acid from acid sludge, in which the offensive vapors were conducted off by an exhaust produced by an induced steam blast while the sludge was agitated with steam.

Fumes, particularly sulfur dioxide, may be evolved at a number of points in treating, separating and concentrating. Batch treatment of lubricating oils is a prolific source of sulfur dioxide, especially when that gas has to be blown out of the oil by air prior to contact clay application. Closed, continuous-treating systems for lighter oils are, of course, free from this nuisance. Sludge separators of the batch type are also large producers of sulfur dioxide, especially when the sludge has had a chance to "ripen" before separation. The volume of sulfur dioxide evolved from sludge from 66 degree acid treatment of gasoline and kerosene distillates was found in one case to be eight times the volume of the sludge when the latter had been allowed to stand only 24 hours before separating. Batch lubricating oil sludge separators, where steam has to be used to effect separation, also add to the quantity of sulfur dioxide produced. Sulfur dioxide also inevitably accompanies any attempt to burn acid sludge direct, or after fluxing, or to burn fluxed or unfluxed residues of separated sludge or solid sludge.

The most prolific source of sulfur dioxide, however, is the acid-concen-



"NATIONAL"
TUBULAR PRODUCTS
for Every Oil and Gas Purpose

Standard of America's Oil Fields

From Well, to Pipe Line, to Refinery—whatever the need may be—there's a "NATIONAL" Pipe for the Purpose.

NATIONAL TUBE COMPANY
Frick Building, Pittsburgh, Pa.

DISTRICT SALES OFFICES IN THE LARGER CITIES

tration plant. The old pan-and-still systems were notorious in this respect. In the Chemico type of concentrator, in the earlier installations, the fumes were scrubbed in packed towers with water. The more recent installations, however, use the Cottrell electrical precipitator. This type of scrubber has the advantage of higher exit temperature for the gases, but any sulfur dioxide not present in solution in water will still pass out to the air. Nevertheless, the Cottrell precipitator reduces the visible fumes enormously. The fumes resulting from the concentration of acid by the Simonson-Mantius vacuum process are taken care of by the water jet condenser which furnishes the vacuum for concentration. This is theoretically advantageous, for the reason that the sulfur dioxide is not mixed with a large volume of inert gases before scrubbing is attempted.

The fume nuisance in batch treating of lubricating oil has been eliminated at some points by putting an exhauster on the agitators and leading the fumes to a high boiler stack. Fumes resulting from batch separators may be minimized to some extent by means of steam or water condensers, and the amount of sulfur dioxide produced can be reduced materially by separating the sludge as soon as produced.

In the disposal of sludges and sludge residues by burning under boilers and stills, distribution of the operation evenly throughout the day is desirable, in order to reduce the concentration of sulfur dioxide in the air at any one time as much as possible. At one point where "acid coke" was being burned under stills with coal, it was necessary to limit the percentage of this material to 20, or below, in order to reduce air pollution to a satisfactory point.

It should always be borne in mind that the higher the stack and the higher the stack-exit temperature, the less chance there is for trouble from these sources. It should also be remembered that it is not the amount but the concentration of sulfur dioxide in the air which leads to complaints from neighbors.

Such complaints are of two kinds. The neighbors may object to the odor of the gas, or gases, and they may claim damage to vegetation. Only a very few parts of sulfur dioxide per million parts of air are required to damage vegetation, and a number of refiners maintain a vigilant patrol of the air of the neighborhood in order to reduce complaints of this sort to a minimum.

Substitutes for Sulfuric Acid

One way to handle the refinery acid-sludge problem is not to make the sludge. A number of substitutes for sulfuric acid have been suggested from time to time, but the majority of these are only auxiliary aids to sulfuric acid in refining petroleum products. Among these may be mentioned materials that depend upon certain absorptive properties for their usefulness in refining operations. Clay, bone char, activiated carbon and silica gel are representatives of this class. These materials can either be used in relatively coarse particles in percolation filters or in a finely divided state by the so-called contact method.

Another class of materials suggested as substitutes for sulfuric acid are certain solvents, such as liquid sulfur dioxide, analine and methanol in admixture with certain aromatic hydrocarbons. These materials owe their refining value to their selective solvent action on certain constituents of the oil which are undesirable in the finished product.

The Edeleanu process, which involves the extraction of the aromatic hydrocarbons by the use of liquid sulfur dioxide, is the only one of these that deserves more than passing mention. This process was particularly designed for the production of good burning oils from certain Rumanian crudes, but it is applicable to other products, especially those requiring fuming sulfuric acid for adequate treatment. The Edeleanu process is in use on a commercial scale at a number of points in the United States, particularly on the Pacific Coast, and it is probable that it will fill a definite need in American petroleum technology.

Another type of refining process applied commercially in recent years is the Gray vapor-phase clay process. This has been applied commercially both at Mid-Continent and Eastern refineries, principally on cracked gasolines.

Except under very limited conditions, none of the above processes, with the possible exception of the Gray process, make it possible to dispense with the use of sulfuric acid completely. Sulfuric acid still has to do the heavy work in refining, and the sludge-disposal problem is like the poor—it is always with us.

Discussion of Dr. J. B. Rather's Paper

The Refinery Sludge Problem

By L. L. DAVIS

WE feel that Dr. Rather's excellent summarization of "The Refinery Sludge Problem," calls for no comments except insofar as our own experience along this line might prove of interest. The Marland Refining Company's acid sludge problem calls for the disposal of 115 tons of lubricating oil and 15 tons light oil acid sludge per day.

Our practice is to separate the acid in the conventional type of open cooking kettle. The proper mixture of gas oil or other fluxing oil, water, light oil sludge and lube oil sludge being cooked with live steam until separation takes place and then settled. It has been found that a careful laboratory control of the process, particularly of the gravities of the component parts of the mixture, assures uniform and satisfactory results.

The cooked sludge settles into three distinct layers. The lower layer consists of the weak acid which is drawn first, and is then charged to the Simonson-Mantine concentration plant. The upper layer is a liquid acid fuel, which is easily handled in the circulating fuel system for firing the distilling equipment.

The middle layer consists of the so-called acid "coke," and presents the most difficult problem. It is soft enough while hot to flow and can be drawn as a plastic mass from the kettles, but when cool sets to a brittle solid which will not soften on reheating. Up to two years ago, our practice was to impound this material.

Since then, we have successfully adapted chain grate stokers to handle this material. The acid "coke" is mixed with one-half its weight of petroleum coke breeze from the cracking stills and the resulting mixture is charged in the usual manner to the chain grate stokers. We have two 100-square-foot stokers under 550 horsepower boilers, and have been able to maintain ratings of from 140 to 160 per cent with this fuel. However, the maintenance problem is severe, as the clips burn out frequently, due to difficulty in holding a uniform distribution of fuel and air over the entire grate.

Recently a new type of burner has been developed by Mr. Wm. M. Duncan and placed on the market by the Illinois Stoker Company, which shows excellent possibilities in handling both solid and liquid waste fuels. Burners of 500, 1500 and 300 pounds per hour have been built and are operating under stills and boilers. Excellent fuel economy is obtained, the flue gases

Here are the requirements for a permanent pipe line corrosion preventive

BITURINE ENAMEL MEETS EVERY ONE

A pipe line coating to permanently solve the corrosion problem must have these qualifications:

1. It must be waterproof.
2. It must be unaffected by soil acids and alkalies.
3. It must have good adhesive qualities.
4. It must not disintegrate with age.
5. It must be incapable of absorption by the soil in contact with it.
6. It must not be affected by underground temperature changes.
7. It must be a dialectric, in order to offer protection against electrolysis.
8. It must be capable of practical and speedy application in the field.
9. It must be unaffected by ordinary handling in the field and not damaged by lowering pipe into the ditch.
10. It must be of substantial thickness.
11. It must be economical.

On this page are shown the 11 qualifications (decided upon by experts) essential in any pipe coating that will give permanent protection against corrosion. BITURINE ENAMEL fulfills every one of them

For more than sixteen years many leading oil and gas industry executives have been successfully solving pipe line corrosion problems with Biturine Enamel—the permanent corrosion preventive. Hundreds of miles of pipe line have been coated with Biturine Enamel and operators have pronounced it entirely successful in giving permanent protection.

Unaffected by Acids, Alkalis or Electrolysis

Biturine Enamel is a heavy, quick-setting bituminous coating, tough but not brittle. It is applied hot and requires no wrapping. Adheres tightly to metal and will not crack. It is absolutely impervious to corrosive elements.

Biturine Enamel is manufactured by Hill, Hubbell & Company as one of a special line of paints for the oil industry.

No skilled labor necessary to apply Biturine Enamel.

Valuable, practical data and specifications furnished upon request.

HILL, HUBBELL & COMPANY

Manufacturers of

Highest Grade Oil Industry Paints and Pipe Line Coatings

Factories at SAN FRANCISCO and TULSA

District Offices:

SAN FRANCISCO LOS ANGELES PORTLAND NEW YORK CITY
SEATTLE TULSA HOUSTON BALTIMORE

Mention Where You Saw the Advertisement

giving form 8 to 11 per cent CO_2 content.

We are now installing a Duncan Burner designed to handle 4000 pounds per hour of solid acid coke, under a 550 horsepower boiler.

The burner itself consists of a cylindrical shell, 7 feet by 16 feet in size over all, fire-brick lined, mounted in a substantially horizontal position on two annular runners resting on four trunnions. In appearance the burner resembles a small rotary kiln. A driving mechanism revolves the entire retort on trunnions.

The fuel is fed into one end of the burner by means of a variable speed screw conveyor. Continual agitation is given the fuel mass by the rotation of the cylinder. In this way the fuel is brought in contact with the hot lining, and gas is evolved which readily ignites, insuring continuous combustion. Air, under forced-draft, is admitted around the feed screw in a radial direction so that the fuel mass is completely consumed. Sufficient air may be used in the burner proper to give complete combustion, or, if preferred, the burner can be operated as a gas producer, and the combustion completed under the boiler or still with secondary air.

The complete installation will consist of the burner as described above, a chain drag conveyor to transfer the suldge from a stoarge hopper to the burner feed hopper an an overhead crane and clam shell bucket for handling the sludge from the drain pits to the storage hopper.

Although the burner is still in the development stage, we feel that it is a valuable contribution to the refining industry and may prove to be a solution to the acid sludge and waste oil disposal problem.

Essential Treating Details for the Hypochlorite Method

(Continued from page 64)

must then discharge 200 gallons per minute plus the chemical solution or water in use.

Water is running into agitator No. 3 at 10 gallons per minute, so water coming from pump No. 3 must flow into agitator No. 2 at 10 gallons a minute although it is mixed with benzine (most of which is run off from a small separator, however). So inter-dependent are the individual units, that each one must be doing the work to time.

The above explanation also applies to the hypoclorite units 4 and 5. The hypo. enters agitator No. 5, after the process is under way, at vat strength, say 1.9.N., and maintains a normality of about 0.4.N. in the body of the agitator. In agitator No. 4, the maintained normality should be about 0.88.N., while the hypo running to waste, from No. 4 agitator, should be about 0.04.N.

A very important fact is, that the waste water from agitator No. 2 must not show even a trace of alkalinity, to the phenolphthalein indicator, because caustic soda interferes with the action of calcium hypochlorite.

When using hypo. the oil also should be tested before the hypo. is used, and the alkalinity kept down as low as possible.

Laboratory Tests

Five ccs. of the hypochlorite is added to 50 ccs. of water and then 10 ccs. of Potassium Iodide (10 per cent solution) added. About 12 ccs. of dilute acetic acid (1 part to 3 of water) is then run in. These are shaken together and titrated with a standard solution of Sodium Thiosulphate, the usual starch solution indicator, being used toward the end of the color change.

Use N/20. Thiosulphate for weak Hypo. (1 cc. equals 0.01.N.)

Use N/2. Thiosulphate for strong Hypo. (1 cc. equals 0.10.N.)

Alkalinity of Ca Hypochlorite.—Five ccs. of the hypochlorite are shaken with 15 ccs. of Hydrogen-Peroxide (3 per cent neutral solution). This mixture is diluted with 50 ccs. of water, boiled and cooled. Two drops of Phenolphthalein are added and the whole titrated with standard H_2SO_4 solution.

N/2 and N/10. Sulphuric Acid for strong and weak hypo. respectively.

Alkalinity of Na Hypochlorite (Ammonia Test)—To 5 ccs of the hypochlorite, add four or five drops of ammonium hydroxide and then boil off all the ammonia. Cool and add a few drops of methyl orange and 50 ccs of water. Then titrate with N/10 Sulphuric Acid to a permanent end point.

Plant alkalinity number, equals, ccs. of N/10 acid used x 8.

Plant Permanganate Test for Treated Gasoline.—100 ccs. of the gasoline are measured into a glass-stoppered shaking-bottle. To this are added 2 ccs of 10 per cent Sulphuric Aid and 1 cc. of Potassium Permanganate (0.1.N.) run in from a burette. Shaking is then immediately started and continued until the pink color of the permanganate bleaches out or turns brown. The time taken to teach this point is taken in minutes and seconds.

This is a very important test and clean samples and bottles are essential.

Laboratory Permanganate Test on Gasoline Shipments.—One hundred ccs of export gasoline are measured in a cylinder, and poured into a standard shaking-bottle. Twenty-five ccs of exactly N/10 permanganate are added from a pipette or burette, and 25 ccs of 10 per cent sulphuric acid from a cylinder. The bottle is then shaken for precisely five minutes, in a standard mechanical shaker. Ten ccs of a 10 per cent solution of potassium iodide are then added and the mixture titrated with N/10 sodium thiosulphate to a yellow color, when starch solution is added and the titration completed.

Then 25 cc minus the ccs of thiosulphate used, equals the number of ccs of permanganate reduced by the gasoline. This number of ccs reduced should not be over six.

The California Natural Gasoline Association has announced that copies of the proceedings of the fall meeting are available and may be procured from the association's secretary, Paul D. Barton, 701 South Palm Street, Alhambra, California, by enclosing $1 to cover cost of printing and mailing. A total of seven technical articles are included in the 66-page booklet, in addition to an all-day talk by Dr. G. G. Brown on "Importance of Natural Gasoline as a Constituent of Motor Fuel." All discussions on the papers and the talk by Dr. Brown are also included in the proceedings.

SKIMMING PLANT

J. D. Wrather, president of the Amarillo Producers and Refiners Corporation, operating a skimming plant at Isom, in the Panhandle district of Texas, announced recently that he and his associates would start immediately on the construction of a skimming plant at Pyote in West Texas. The company has contracted for a supply of Winkler County crude sufficient to last over a period of two years and reported as one million barrels. The plant is to have a capacity of 2000 barrels daily.

Bell Oil & Gas Company, operating a refining and cracking plant at Grandfield, Oklahoma, with headquarters at Tulsa, is contemplating the construction of a second refinery at Sweetwater, Texas, and the laying of a 70-mile pipe line from the Howard pool, Howard County, Texas, to its proposed plant.

TWO FIRES AT LONG BEACH

One life was lost and considerable damage was done in two fires at Long Beach, California, in February. In the Los Cerritos section, an explosion in the Signal Gasoline Company's plant blew the roof from the plant and ignited six derricks, four automobiles and several oil tanks. Several days after the fire, a compressor in the California Petroleum Company's main plant in the field blew out, causing an explosion which blew up part of the roof.

Proper Insulation for Refineries

By H. S. BELL, *Petroleum Engineer*

Mr. Bell was asked to discuss the problems of refinery insulation before the recent sales convention of the Banner Rock Products Company at New York and the following material is taken from his more complete discussion. As Mr. Bell was addressing salesmen representing the manufacturing part of the industry, his talk was largely confined to an outline of refinery insulation requirements and the manufacturer's opportunity to meet these requirements. However, his remarks contain much of value to the plant operator, and further stress the need for a better understanding of this particular phase of plant operation.

THE refiner is in reality interested in one vital question: "How many heat units may I save per dollar invested in insulation?" At first glance, the answer might appear to be: "Choose that insulation of the greatest thermal efficiency." My observation is to the effect that we are sometimes led astray by such an assumption.

Structural adaptability, method of application and durability are all factors of equal importance to efficiency. Averaged over the expected years of useful life, many insulating materials have very satisfactory efficiency as non-conductors. Their structural adaptability and method of application may vary widely.

Take the question of adaptability, provided that the material will withstand the maximum temperature it will encounter, it must also meet severe conditions as far as actual misuse is concerned. The piping around the stills, for instance, is often being altered. Workmen must walk and climb about them. This is no place for fragile or compressible material. Furthermore, extreme conditions of temperature result in problems from expansion. Not all material has sufficient elasticity or perhaps cannot be applied in a manner to overcome this difficulty. The method of application is also most important. It is needless to comment upon the necessity of thorough weatherproofing, yet careless work on this important part of the job has probably ruined more refinery insulation than all other causes.

In passing, I want to comment on one special feature of refinery insulation. The central station may anticipate a reasonable expectancy of 20 years or even more of useful life. Likewise, many other industrial plants. The refinery, so the saying goes, that is not rebuilt every five years, is out of date. Thus the oil man must write off more for obsolescence than for actual depreciation. Provided he can maintain his process temperatures, he often would prefer to spend a little more for fuel than a lot for obsolescence. We, therefore, often see him choose an 85 per cent efficient insulation job at say, two-thirds of the cost of one 95 per cent efficient. Do not blame him. He knows what he is doing. Sell him instead on a structurally sound and durable job, and emphasis on salvage when making changes will do no harm.

The above, sets forth in a general way, the refiners' insulation problems. You are probably interested in a more detailed description of the individual pieces of equipment you may be called upon to insulate.

To go back to the stills. Two types of atmospheric stills are in use, the horizontal cylindrical, either batch or continuous, and the pipe still. Horizontal cylindrical stills will range from eight to 15 feet in diameter and from 20 feet to 45 feet in length. Structural problems of supports and settings fixes the upper limit. The upper half of the shell and the two heads must be insulated. Oil temperatures of 500 degrees to 700 degrees are encountered. Expansion of shells and considerable vibration may be anticipated. Therefore, the insulation must be well anchored. Angle clips along the shell and around the heads will provide anchorage for lacing cables. A most careful weatherproofing coat is essential.

To any continuous battery will be attached heat exchangers, vapor or residuum type or both. Both types are today usually of shell and tube construction, the cold oil passing through the tubes on its way to the stills and being surrounded by hot vapors or residuum, as the case may be. Residuum exchanger shells will approach the temperature of the hottest oil in the system. Vapor exchangers will range from fairly low temperatures of 250 degrees or so up to 600 degrees.

Exchanger shells are usually circular, although two well-known makes, Leach and Southwestern, are rectangular in sections. Diameters range from 24 inches up to 60 inches. Lengths rarely exceed 16 feet, due to expansion difficulties with longer tubes. Durability and weatherproof coatings are essential features of their insulation.

Bubble Towers

Bubble towers are being rapidly introduced to the oil industry. Here insulation is most important that uniform temperatures may be maintained. As applied to continuous still batteries, bubble towers will range from four feet to eight feet in diameter and from 20 feet to 30 feet in height. Since their use is largely confined to separation of the lighter products, temperatures will rarely exceed 450 degrees. In applying insulation to towers, circular angles welded to the shells at six to eight feet spacing are essential for anchorage of lacing cables.

Where exchangers are used, vapor and residuum piping is, of course, insulated. For economy, the feed line through the exchangers and the flow line from still to still should be covered. When bubble towers are used, it is essential that the pipe be insulated right up to the tower.

Pipe stills as previously described, embraced a separator or evaporator wherein mixed hot oil and vapors from the pipe coil are discharged. From an insulation standpoint, this evaporator is one of the most important pieces of refining equipment. The temperature must be kept constant if efficient fractionation is to follow. It should be noted that the temperature of the separator is also the highest of all refinery equipment excluding cracking stills. These temperatures will range from 450 degrees for simple skimming operation, up to 800 degrees for a high percentage of overhead distillate.

The bubble towers of the pipe still may be individual from the separator or may be mounted above it to make one big tower. In the latter case, towers have been built up to 12 feet in diameter and 115 feet high. These big towers represent a real problem in structural strength, anchorage and elasticity for the insulation contractor.

Soaking Drum

The conventional liquid phase cracking plant follows closely the description of a pipe still with the addition of one important piece of equipment, the reaction chamber or "soaking drum." This may be horizontal or vertical; four or five feet in diameter by 40 feet long and horizontal, as in the Cross system, or 10 feet by 20 feet to 30 feet high, set vertically as in the Dubbs process. The purpose of the soaking drum is to hold the heated oil under the desired conditions of temperature and pressure a certain length of time. Temperatures of 750 degrees to 900 degrees may be expected in this reaction chamber. To hold it requires the best kind of an insulation job. The rest of the cracking plant, such as evaporators, bubble towers and exchangers, resembles similar parts of the modern pipe still, except that relatively higher temperatures are encountered.

Turning from hot to cold, let us look at the refiner's refrigerating equipment. The usual type used is the absorption system. The plant proper requires no comment, as it is the standard equipment used in ice plants everywhere. Brine circulation is universally used for cooling the oil. For chilling crystalline wax-bearing distillates, two general types of machines are used. The first consists of a six-inch pipe within an eight-inch. Oil and wax are pumped through the six-inch, aided by a helical scraper. The brine is around the six-inch pipe within the eight-inch. Sev-

eral stands of double pipe are assembled into a "chilling machine." The other type resembles a gigantic ice cream freezer. Between an inner and an outer shell, brine is circulated. Oil is within the inner shell, and revolving paddles keep it in motion.

After leaving the chillers, the oil is passed through plate presses to remove the wax solidified by the chilling.

Amorphous wax is either tank settled or centrifuged at temperatures approaching 10 degrees. In case of centrifuging, the chilling is done in tanks so that the insulation problem is similar with either method. Roofs, shells and bottoms of tanks must be insulated. The tanks are universally upright, cylindrical tanks of diameters ranging from 12 to 35 feet with heights approximately the same as diameters. Weatherproofing of shells and roofs is most important.

For best results it is important that all of this equipment be well insulated not only to conserve refrigeration, but also to maintain uniform temperatures.

While refiners will acknowledge the value of insulation on stills and steam lines, and possibly on their refrigerating machine proper, it is astonishing how many will leave brine lines, chillers and settling tanks bare. They have an idea that a layer of ice is as good as insulation.

It is needless for an outsider to dwell at length upon the specifications for cold insulation, but I do want to emphasize the necessity for a moisture proof job. To be moisture proof a covering must not only be waterproof, but also practically air proof. Saturated air leaking into the cells of cold insulation precipitates moisture, the moisture freezes and away goes the insulation.

In conclusion, there are two fields for insulation in oil refineries that may be developed further.

The first of these is fireproofing. Around modern stills we have lots of structural steel supporting towers, exchangers, condensers, etc. Unless fireproofed, this constitutes a serious risk. A spill of oil on the ground, a flash and there is a hot fire. Unprotected steel work will quickly fail and the collapse of the supported equipment adds to the fire. Concrete and brick-work have been used successfully for protection. However, if the job is a big enough one, insulation by non-conducting materials is often economical.

The second field is older and there has been more development work. I refer to reduction of evaporation losses. When tanks undergo a change in temperature as from day to night, there is a big loss due to so-called "breathing." At night as the tank cools down, the vapors condense in volume, drawing in air; as the temperature rises during the day, the volume of gas over the oil expands and is expelled from the tank. The next night the process is repeated. Thus air is drawn in, saturated with valuable gasoline vapor and expelled. Anything that will minimize temperature changes will help to cut down breathing losses, and properly applied insulation has a big field for this purpose.

Schultz Vacuum Process Lube Plant in Louisiana

Bayou State Refining Company, a subsidiary of the Bayou State Oil Corporation of Shreveport, has under construction an 800-barrel capacity lubricating oil plant at Hosston, Louisiana, in the Hosston field.

The company decided to erect the latest type of lubricating oil plant equipment only after exhaustive test and experiments conducted by company engineers and the research staff of the Graver Corporation. The refinery will consist of a pipe still, the Schultz vacuum process and two shell stills, with conjunctive equipment such as tanks, pumps, etc. Graver Corporation of Chicago is installing the plant equipment. Operations are to start May 1.

Hosston crude is probably unique in its physical characteristics, since the crude itself, which contains no gasoline or kerosene, has extremely low cold test, and comparatively low gravity—19.5 degrees A. P. I.

The products to be made at the plant upon completion will consist of 45 per cent lubricating oil, the remainder going into residuum and gas oil—which will be blended together according to present plans. The Bayou State has been operating a small refinery on the present site for several years, producing a lubricating oil having a cold test of about 15 below zero Fahrenheit.

The low cold test of all the lubricating oil fraction derived from the refinery is not the only peculiar quality or characteristic of this crude, since these fractions are possessed of a relatively high flash and fire test. In addition the viscosity of these fractions is reasonably high at 100 F. with a surprisingly high viscosity at 210—which is unusual with asphalt base crudes. The characteristics of crude and lube oil fractions, except the cold test, are practically speaking, the exact opposite of that which should be expected from an asphaltic base crude such as Gulf Coastal oils, California crudes and Smackover oil. The Hosston production seems to possess all of the characteristics of a paraffin base crude insofar as the quality of the lubricating oil fractions is concerned, high flash, high viscosity at 210, 3 to 3½ color (without treatment or filtration) and a very low cold test, which on some fractions runs as low as 30 below zero.

The plant, when completed will produce gas oil tops, which will be blended back with the residuum to produce a fuel oil having a gravity of about 21 degrees A. P. I. Forty-five per cent of the charge will be converted into five cuts of lubricating oil ranging from 140 to 1275 viscosity at 100. All of these fractions will have cold tests well below zero. The lubricating oil streams are accumulated with color of 2½ to 3, and no chemical treatment or filtration is required to finish these stocks, according to C. F. Knox, general superintendent.

The company has been marketing its product in the northern territory. The newer installation is replacing the old plant which was dismantled in January. The new equipment will make possible the production of greater quantities of lubricating oils from the company's production of 18,000 to 20,000 barrels monthly. Sufficient crude from other producers in the same field has been contracted for to keep the plant running at its rated capacity of 800 barrels daily.

An unusual feature of the plant is that it will be electrically operated throughout. The company generates its own electricity through the use of Allis-Chalmers steam turbines driving generators of the same make, and producing sufficient electricity for the operation of the plant, electrically pumping the company's 60 producing wells, and for lighting the plant and the town of Hosston. Four Casey Hedges 250 H.P. boilers comprise the power plant.

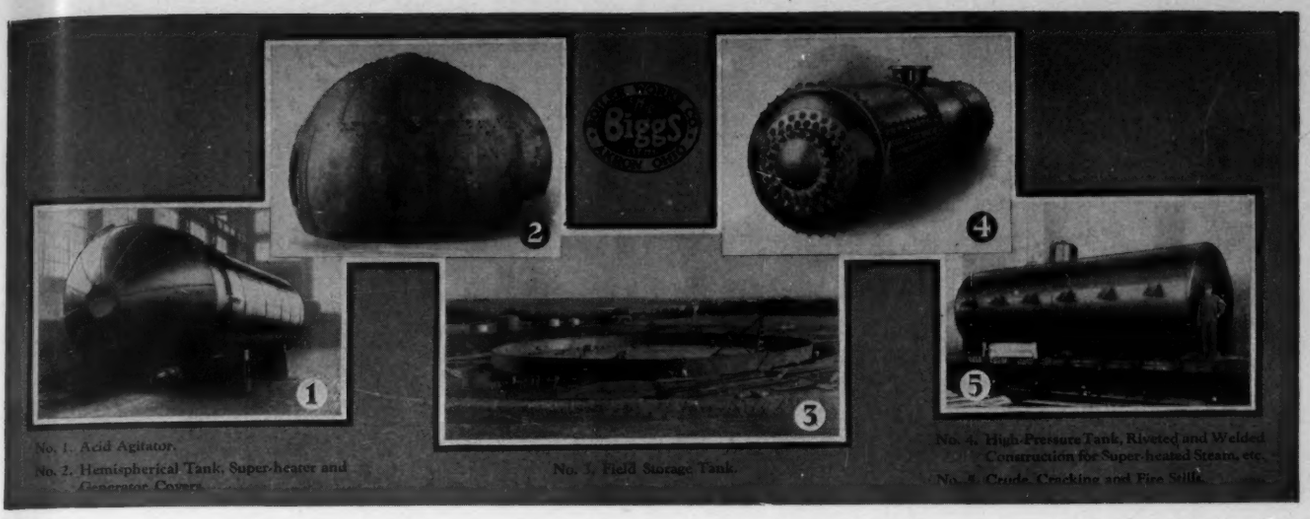
Further information indicating the unusual or peculiar type of lubricating oil extracted from the Hosston crude is presented in the following specifications of the grade formerly produced at the old plant:

Flash, 450/60.
Fire, 520/530.
Gravity, 22.7/23.2.
Viscosity at 100, 750/75.
Viscosity at 210, 65/67.
Color, 3/3½.
Cold test, Minus 15/10.

In addition, certain fractions of this oil have been refined to a colorless, tasteless, and odorless, medicinal oil. Standard Oil Company (Indiana) has been taking it under contract for this purpose for the past four or five years, running an average of 140 barrels daily in the manufacture of this mineral medicinal oil.

The Leeds and Northrup Company of Philadelphia have opened a Mid-Continent sales office in Tulsa with Boyd F. Koepke in charge.

Midwest Refining Company, operating four natural gasoline plants in the Salt Creek field, is now erecting its fifth plant in this area.



No. 1. Acid Agitator.
No. 2. Hemispherical Tank, Super-heater and Generator Covers.
No. 3. Field Storage Tank.
No. 4. High-Pressure Tank, Riveted and Welded Construction for Super-heated Steam, etc.
No. 5. Crude Cracking and Fire Stills.

For Every Steel Plate Requirement

Agitators, tanks, stills. Compounding kettles, breechings, condenser boxes. Biggs fabricates and erects all sorts of steel plate work used in refinery and oil country service.

Whenever you need dependable heavy steel plate construction of any kind you will find Biggs a prompt and effective source of supply for both standard and special types of work.

The table at the right gives an idea of some of the equipment built by Biggs. In experience, in personnel and in facilities, Biggs is qualified to supply all your heavy steel plate requirements.

Your inquiry on steel plate construction of any kind will receive prompt and courteous attention. The coupon below brings a copy of our interesting folder "What Biggs Does and How." Mail it today.

Manufacturers of

- Pressure Stills for Cracking Process
- Fractionating Towers
- Dephlegmating Towers
- Bubble Towers
- Heat Exchangers
- Agitators
- Steam Stills
- Crude Stills
- Condenser Boxes
- Run Down Tanks
- Blending Tanks
- Hemispherical Tanks
- Blow Cases
- Acid Tanks
- Compounding Kettles
- Storage Tanks to 80,000 Barrels
- Smoke Stacks and Breechings etc.

THE BIGGS BOILER WORKS COMPANY

General Offices and Works: Akron, Ohio
Eastern Sales Office: 300 Madison Ave., New York City
Chicago Office: 35 South Dearborn Street

Now is the right time to mail this coupon

THE BIGGS BOILER WORKS COMPANY
Akron Ohio

Please send us, without obligation, a copy of "What Biggs Does, and How." We are interested in the following equipment.....

Please see us on or about .....

.....

Firm .....

Individual . ...

Address . .....

The Biggs Boiler Works Co. Akron Ohio Est. 1857 — TRADE MARK REGISTERED

TANKS AND GENERAL
STEEL PLATE WORK
for the Oil Industry

Mention Where You Saw the Advertisement

Many Plants Proposed for West Texas

Flood of cheap crude offers inducement for refiners with plants located near source of supply

By H. H. KING
Staff Representative

FORT WORTH, Texas—Refinery construction in Texas has been particularly active since the first of the year, and the surplus supply of comparatively cheap priced crude in the West Texas district has resulted in more skimming plants being started in this district than in all other sections of the Southwest combined. Three new plants have been put in operation in the West Texas district since the first of the year, and eight more are under construction, or contracted for prompt erection. Other sections of the State are also adding plants, as construction work on one each has been started at Pampa, Laredo and Dallas.

Eight skimming plants with a combined capacity of 31,900 barrels daily are now operating in the West Texas district, as shown by the accompanying table, and the new plants building will practically double this capacity. The majority of the new plants are to be located on the Texas & Pacific Railroad in Ward County, and about 20 miles south of the Hendrick field, Winkler County, where an overproduction of 28-30 gravity sulphur contaminated crude exists.

Salvaged Equipment

Second hand equipment salvaged from dismantled plants in older oil producing areas in the State, and some equipment from adjoining States is being used to a great extent by the companies making small plant installations in the West Texas district. Builders of this type of plant are endeavoring to hold down their initial investment to a minimum, and are playing for a quick turnover while crude is plentiful and somewhat cheap.

Hendrick field crude has been made available for long period contracts at prices ranging from 60 to 75 cents per barrel delivered to plants on Texas & Pacific Railroad in Ward County, or loaded in buyers' cars on same railroad. This is the cheapest priced crude placed within reach of the independent refiner since the flush days of Smackover, and the former crude is a much better grade, although selling near the average low price paid for Smackover crude delivered to plants.

10,000 Barrel Plant

The most modern plant now under construction in West Texas is being erected by the Pasotex Petroleum Company, subsidiary of Standard of California, at El Paso, with an eight-inch pipe line connecting with the Hendrick field. This refinery and pipe line project is scheduled for completion about August 1, 1928. The refinery will be equipped to handle about 10,000 barrels daily, and is to be modern in every respect. W. G. Hamilton, formerly assistant refinery superintendent of the Richmond plant of the Standard Oil Company of California, is in charge of the construction work on the El Paso plant, with headquarters in the First National Bank Building, El Paso. The output of this plant will be marketed mostly in the Rocky Mountain States and Northern Mexico.

Two 5000 barrel skimming plants are scheduled to start building shortly at Monahans and Sweetwater. The Crystal Oil Refining Corporation, which is operating two plants at Cedar Grove, La., plans to erect the Monahans plant, and if the project is carried out will invest about $400,000. Arrangements have been completed for an adequate crude supply from the Hendrick field. Crystal has been operating on Hendrick crude for a number of months at its Cedar Grove plant.

Reese S. Allen, president of the Amarillo Refining Company, which has a skimming plant at Amarillo, Owen-Sloan Oil Company and the F. H. E. Oil Company are forming a new company to erect a 5000 barrel skimming plant at Sweetwater. The same interests also plan to lay 60 miles of six-inch line from the plant to the Howard County production controlled by the Owen-Sloan Oil Company and the F. H. E. Oil Company, thus providing a market for a large amount of 26 degree gravity and some 31-32 degree gravity crudes now shut in for lack of a market.

The Wickett Refining Company was organized in March to erect a 2500-barrel refinery at Wickett to operate on "tops" to be furnished by the Blue Bonnett Oil Refining Company and also on Hendrick field crude. Two shell stills and one pipe still are being installed by the Wickett Refining Company, and operations are to begin about middle of May, 1928. Some of the equipment for this plant was obtained from dismantled

(Continued on page 122)

Refineries Operating in West Texas

Company—	Location	Daily Capacity
Humble Oil & Refining Company	McCamey	12,000
Col-Tex Refining Company	Colorado	8,000
Bluebonnett Oil Refining Company	Wickett	4,000
Pecos Valley Refining Company	Pyote	2,500
Rio Grande Oil Company	El Paso	2,500
San Angelo Refining Company	San Angelo	2,000
Odessa Refining Company	Odessa	600
Sweetwater Refining Company	Sweetwater	300
Totals		31,900

Building or Proposed Plants

Refineries under construction and proposed for prompt erection in the West Texas district are listed below by companies, including plant location and estimated daily capacity:

Company—	Location	Daily Capacity
Pasotex Petroleum Company	El Paso	10,000
Crystal Oil Refining Corporation	Monahans	*5,000
Reese S. Allen et al	Sweetwater	*5,000
Joe and Louis Olsen	Pyote	*3,000
Constantin Brothers et al	Pyote	3,000
Wickett Refining Company	Wickett	2,500
J. D. Wrather et al	Pyote	*1,500
Big Lake Refining Company	Big Lake	1,000
Totals		31,000

*Indicates proposed plants.

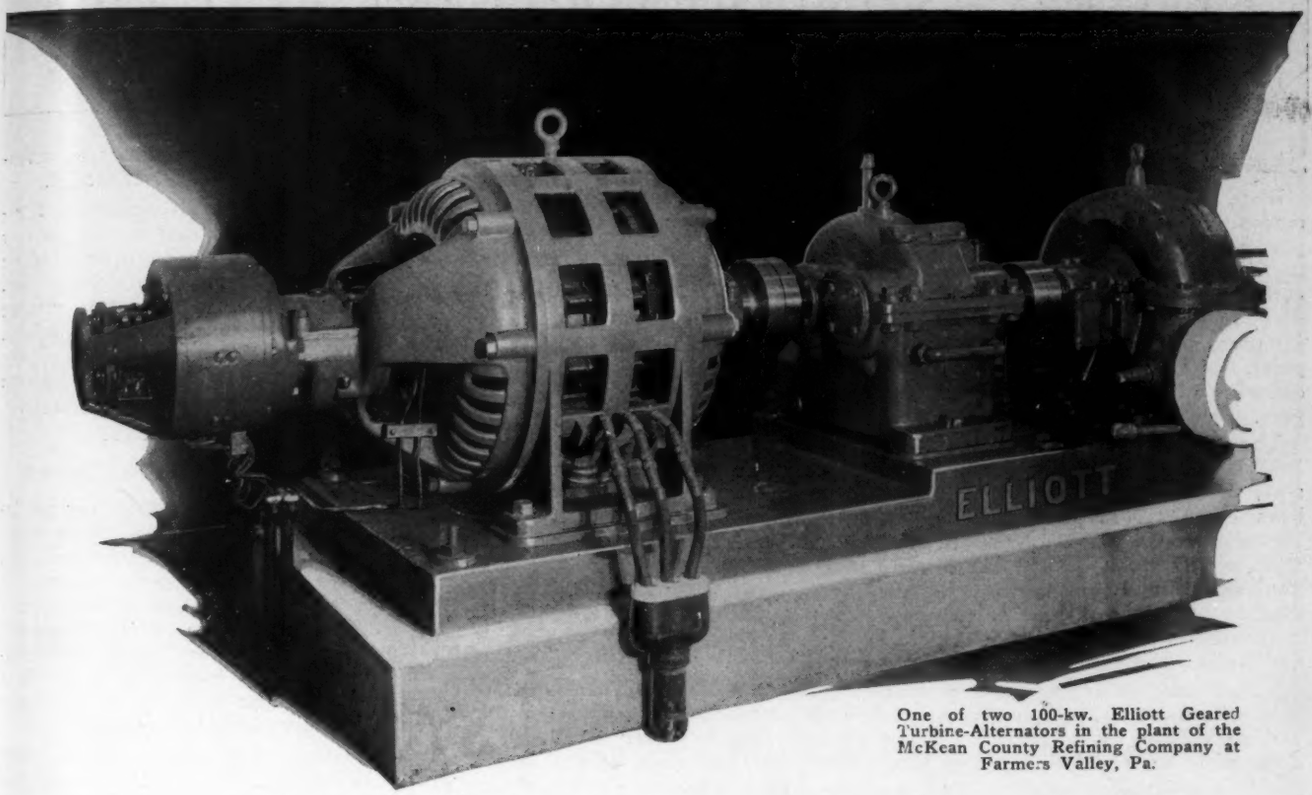
Other Sections

Refineries under construction in other sections of Texas are listed below by companies, including plant location and estimated daily capacity:

Company—	Location	Daily Capacity
Pampa Refining Company	Pampa	2,000
Motor Fuel Products Company	Laredo	1,750
Everybodys Oil & Gas Company	Dallas	1,000
Totals		4,750

*Indicates proposed plants.

ELLIOTT for Turbine-Generators



One of two 100-kw. Elliott Geared Turbine-Alternators in the plant of the McKean County Refining Company at Farmers Valley, Pa.

Dependable, economical power —and steam for distillation

The McKean County Refinery at Farmers Valley, Pa., is isolated from outside electric power sources and dependent upon its own plant for generating electric current. Two 100-kw. Elliott Turbine-Generator Sets give them power at very low cost, and service "as good or better than could be had from outside sources," they say.

The economy of the plant is very high as they are able to operate their turbines as reducing valves, taking steam from the boilers at 125 pounds pressure and operating the turbines against a back pressure of 25 pounds, utilizing the 25-pound steam for distillation purposes. The power load on the turbine is balanced nicely against the exhaust steam requirements.

The power is used for lighting the plant, operating continuous circulating pumps in the refrigeration plant, operating centrifuges and various conveyor equipment.

Many refineries are in position thus to skim very cheap power from process steam. If your power requirements overbalance the process steam needs, a bleeder type turbine might serve better than a straight non-condensing unit.

Let our engineers go into the proposition with you.

ELLIOTT COMPANY
PITTSBURGH, PA.
General Sales Offices **JEANNETTE, PA.**
District Offices in principal cities

Elliott Power Equipment includes engines and turbines, generators and electrical machinery, condensers, deaerators, heaters, centrifugal blowers and accessory equipment.

H-523

REFINERY AND GASOLINE PLANT ACTIVITIES

New Plants – Construction Notes – Personel Changes

Start Operation in April

Dixie Oil Company will complete the reconstruction of its refinery at Superior, near Vivian, Louisiana, and place the installation in operation some time during April. A. O. Hodges, construction superintendent, from Standard Oil Company's Sugar Creek, Missouri, plant, has been in charge of the reconditioning work since November of last year.

The Dixie refinery, which is rated at 1500 barrels daily, consists of five shell stills in the first battery, which have been completely repaired during the reconditioning period. Each of the stills, which are hooked up in continuous series, is equipped with a bubble type fractionating column of company design, consisting of nine bubble trays per tower.

The second battery consists of four shell stills in series, equipped with conventional baffle type towers. When these stills are in service, refinery capacity is greatly increased.

All of the buildings, such as office, warehouse, pump house and receiving house, are of brick construction with concrete floors. The water well is located near the brick boiler house.

In addition to the agitators installed when the plant was erected several years ago, the new owners have installed a continuous treating system, consisting of four vertical treating columns.

The new equipment also includes a small experimental still which will be operated by the laboratory staff conducting experiments in cracking and methods of increasing recovery and lowering costs in the processing of Pine Island crude production owned by the Dixie Company.

KERN PLANT DISMANTLED

The King refinery, built about 20 years ago and one of the first independent plants erected in Kern County, California, is being dismantled. The plant has not been in operation during the last three years. This company was the first small organization to commercialize the manufacture of lubricating oil from the heavy Kern River crudes.

Will Erect Carbon Black Plant in Shamrock Field

Amarillo, Texas.—The Western Carbon Company has contracted for the residue gas from the Bryant-Phelps et al's natural gasoline plant in the Shamrock field, Wheeler County section of the Texas Panhandle, and will erect carbon black plants to burn about 12,000,000 cubic feet of gas daily. A site has been purchased in the east one-half of the southwest quarter of section 42, block 24, H. & G. N. survey, near the natural gasoline plant, and some of the equipment will be salvaged from a dismantled plant in Louisiana. One unit of the standard type offering an average yield of about 1½ pounds of carbon black per 1000 cubic feet of gas will be erected, while a smaller unit making high grade carbon black will also be erected. The latter will recover from three-quarters to seven-eighths of a pound per thousand.

Western Carbon Company is reported to be planning to add another burning unit to its plant, located on the Carson - Hutchinson County line, Texas Panhandle district, thus making it one of the largest in the country. This obtains the bulk of its gas supply from residue off Phillips Petroleum Company's natural gasoline plants.

VAPOR PHASE PROCESSES

Pure Oil Company, operating one installation of Gyro vapor phase cracking process at its Cabin Creek, W. Virginia, refinery, is now constructing the second installation at its Smith's Bluff plant near Beaumont, Texas, and plans several more. Pure Oil Company is largely interested in the Gyro Process Company, licensors of the new vapor phase cracking process.

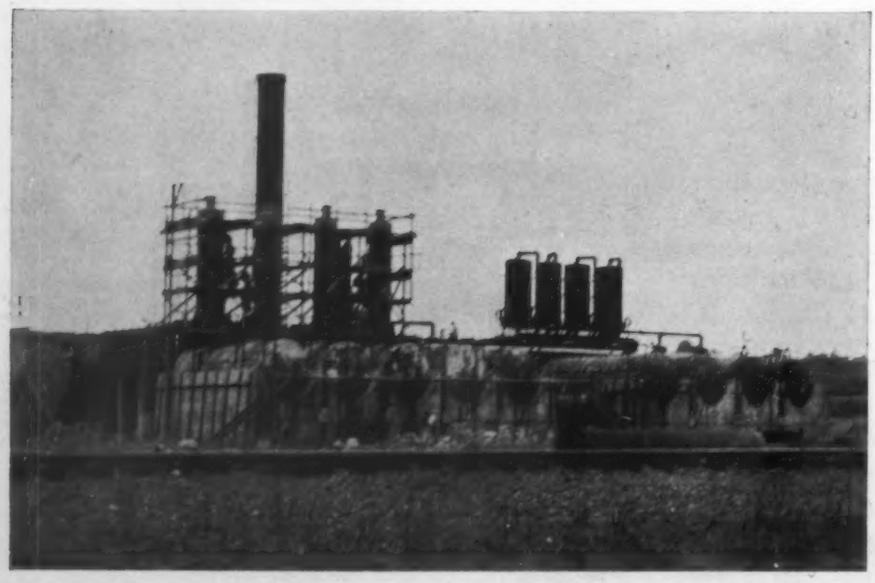
Another vapor phase cracking plant is being erected under the direction of Luis De Florez, consulting engineer of New York, for the Gulf Refining Company and The Texas Company, which two organizations have reached an agreement on two groups of patents they control and are going ahead developing the process jointly. Among other large companies interested in or developing vapor phase processes is Sinclair Refining Company which has been investigating certain processes for some time.

REFINERY DOUBLES CAPACITY

Orange County Refining Company at Newport Beach, California, plans the early reconstruction of its asphalt plant and expects to double the capacity of the former installation. The plant, which was damaged to the extent of $25,000 by fire, including the destruction of coolers, warehouse, tanks and derrick of a nearby well, has twice been burned since its erection two years ago. The latest modern equipment is being installed and the new plant will have a capacity of about 100 tons of asphalt daily. The company has built up a wide market for its various grades of asphalt derived from the Newport field production.

OIL CHEMISTS MEETING

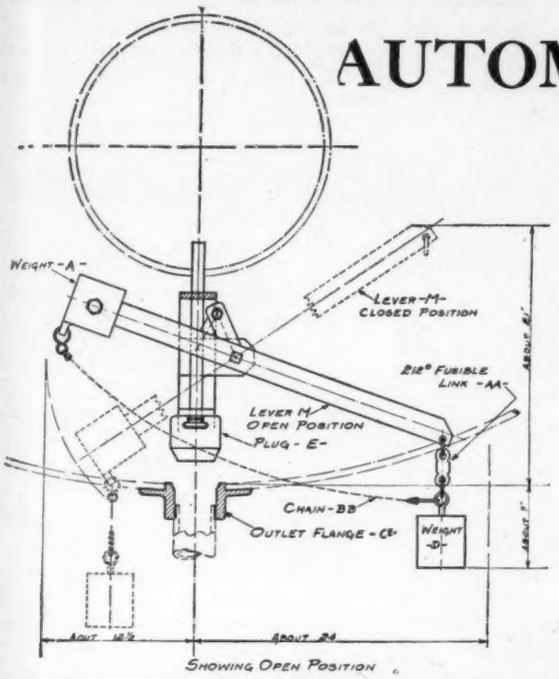
The American Oil Chemists Society is to hold its annual meeting this year at the Roosevetl Hotel, New Orleans, Louisiana, on Monday and Tuesday, May 14 and 15. An attractive program has been prepared. Railroads will give an excursion rate of a one and one-half fare on the certificate plan.



Progress picture taken at Dixie Oil Company's Superior, Louisiana, skimming plant, during March. The reconditioned refinery is to be placed in operation during April, running Pine Island crude.

OCECO PRODUCTS
on the Stills

AUTOMATIC TAR PLUGS



Showing Open Position

THIS is the protection every still needs. Then, in case of a tar line fire the contents of the still are not emptied into the fire.

Stop cocks do not protect—when a line breaks the oil begins to burn *immediately* with the result that a man cannot get to the stop cocks to close them.

The only sure protection is an automatic tar plug

STILL SAFETY VALVES

A THOROUGHLY efficient unit that provides for the relief of both excessive pressure and vacuum within the still.

Furnished for any vacuum desired and pressures up to 30 lbs.

LOOK BOXES

A PRACTICAL, efficient method of controlling the operation of your stills.

The complete cylinder of tough Pyrex glass gets away from the old breakage troubles and gives an entirely unobstructed view of the stream.

Send for the Oceco Catalog containing full description of these units and other equipment which will save you money.

THE OIL CONSERVATION ENGINEERING COMPANY

877 Addison Road — *Headquarters for Tank Equipment* — Cleveland, Ohio

25 Broadway, New York
Box 552, Beaumont, Texas
417 So. Boulder St., Tulsa, Okla.
Neilan, Schumacher & Co., Los Angeles, Cal.

OIL TANK OCECO EQUIPMENT
SAVES EVAPORATION AND PREVENTS FIRE

CANADIAN COMPANIES MERGE

McColl Brothers, Toronto, and Frontenac Oil Refineries, Ltd., of Montreal, have merged to form a new company known as McColl-Frontenac Oil Refineries, Ltd. The new company is headed by John Irwin, who is the head of large paint and dye manufacturing companies in Canada in addition to interests in other businesses; other officers and directors have not all been selected at this time.

The merger included two refineries and about 50 bulk distributing plants and other marketing facilities throughout the Dominion. The new company has taken exclusive license from the Gyro Process Company to operate the Gyro vapor phase cracking process in Canada. This license includes the right to re-license the process in the Dominion. J. W. McColl, formerly president of the McColl Brothers Company, relinquished his interests and has severed connection with the organization.

The new company now has one unit of the Gyro process operating at a daily capacity of 750 barrels of finished Gyro motor fuel. This unit is located at the Frontenac refinery at Montreal. This unit has been in operation for some time, and much of the experimental work necessary for the perfection of the Gyro process was carried out with this installation. Pure Oil Company, Chicago, owns an extensive interest in the Gyro Process Company, and is the active technical head of that organization. Pure has one Gyro unit in operation at Cabin Creek, W. Va., and is now erecting the second installation at its Smith Bluff refinery in Texas.

McColl-Frontenac Refineries, Ltd., has started construction of its second Gyro vapor phase unit at the McColl refinery at Toronto, which will have a capacity of 1000 barrels finished gasoline daily. It is thought that a third unit may be installed at Winnepeg in the near future. The Frontenac refinery at Montreal consists of a 3000-barrel skimming plant and the 750-barrel Gyro installation. The McColl refinery at Toronto is rated at 1500 barrels, but is being enlarged to 3000 barrels through the installation of a new tube still.

DOUBLES CAPACITY

Shreveport Producing & Refining Company recently completed a $250,000 improvement program at its Jewella, Louisiana, refinery. Through the addition of a new 5000-barrel pipe still, plant capacity has been increased from 5000 to 10,000 barrels daily. Additional tankage is provided for handling products from the plant. The refinery is located on a 186-acre tract, providing ample space for expansion. Shreveport-El Dorado Pipe Line Company, parent organization of the refining company, is erecting two 80,000-barrel crude tanks on the property.

The plant now has nine shell stills, equipped with Winkler & Kock bubble type fractionating columns, and the new Kellog pipe still with bubble type towers. This still will produce gas oil for processing through the company's Jenkins & Dubbs cracking units.

SKIMMING PLANT PROPOSED

San Angelo, Texas. — Proposing to erect a 5000-barrel daily capacity skimming plant for handling Hendrick field crude, the Crystal Oil Refining Corporation, which has a refinery at Cedar Grove, Louisiana, is negotiating for a plant site on the Texas & Pacific Railroad near Monahans, Ward County. Crystal has made tentative arrangements for a crude supply from an independent producer in the Hendrick field.

EDELEANU PLANT IN GERMANY

Regarding the use of liquid sulphurous acid for refining petroleum distillates as compared to sulphuric acid, Walter Roth, Gothen-Anh, Germany, writing in Industrial and Engineering Chemistry, states that the first of this type of chemical treating plant is functioning satisfactorily at Hamburg-Grasbrook.

On this subject Mr. Roth has the following to say:

"More than 25 years ago the Roumanian, Edeleanu, recommended liquid sulfurous acid for refining petroleum distillates in place of concentrated sulphuric acid, which resinifies or destroys the unstable petroleum constituents. The sulfurous acid has a greater solvent power for the unsaturated hydrocarbons and the oxygen-containing constituents of the crude petroleum; hence it is possible to obtain the less soluble hydrocarbons and paraffins in pure condition. The first large-scale plant of the Rhenania-Ossag-Mineralolwerke A. G., at Hamburg-Grasbrook, has been in operation for a short time. By Edeleanu's process not only the benzine or light oils but also the lubricating oils can be refined. Furthermore, it is possible to eliminate almost completely the moisture from the circulating liquids, so that the apparatus suffers no corrosion from the sulfurous acid. Only 200 kg. of steam and 3 kilowatt-hours were necessary for refining a ton of distillate. Five hundred tons per day are refined in the plant. Furthermore, all difficulties of working with a solvent of such a penetrating odor and a boiling point of —8 degrees have apparently been completely surmounted."

Tulsa.—A 3500-gallon compression and absorption gasoline plant is being constructed by the Grimes Gasoline Company near Weleetka, Oklahoma, and when finished will strip the gas used in that city's power plant.

Plan Absorption Plant in Hendrick Area

San Angelo, Texas.—Natural gas contracts are being solicited from producers in the Hendrick field, West Texas district, by Humble Oil & Refining Company on a 25 per cent royalty basis as a preliminary step toward the construction of a 20 million cubic foot daily capacity absorption plant in the field proper. This field is credited with having more natural gas going to waste daily than any other in the country, and because of very small gasoline yield has not attracted plants previously. The crude tests about 30 degrees gravity and carries a sulphur content of about 1.53 per cent, according to Bureau of Mines' analysis. In order to avoid high expense in treating out the sulphur, and transportation costs in reaching a market, it is expected that Humble will pump the natural gasoline manufactured into its crude lines, as is now being done with natural gasoline purchased on contract from Phillips Petroleum Company and Skelly Oil Company in the Texas Panhandle district.

ENLARGE GASOLINE PLANT

Roxana Petroleum Corporation is enlarging its natural gasoline plant at Marshall, Logan County, Oklahoma. The first equipment was placed in operation about three months ago, having a capacity of 10,000 gallons daily. The new units being installed will increase this gasoline production to 20,000 gallons. The Roxana is securing gas for treatment in this plant from three Logan County wells, and the gasoline content of this gas is averaging 2½ gtllons per thousand cubic feet. Location is in the southwest of section 19-19n-14w.

PERU MAY HAVE REFINERY

A bill is to be presented to the Peruvian government requesting that permission be granted for the erection of a refinery in that country. The plant is to operate as a Peruvian company, but is to be financed and constructed by American capital. Bethlehem Steel Corporation, which built the refinery for the government in Argentina, is reported to be interested in the new plant in Peru.

SUGAR CREEK GETS GAS

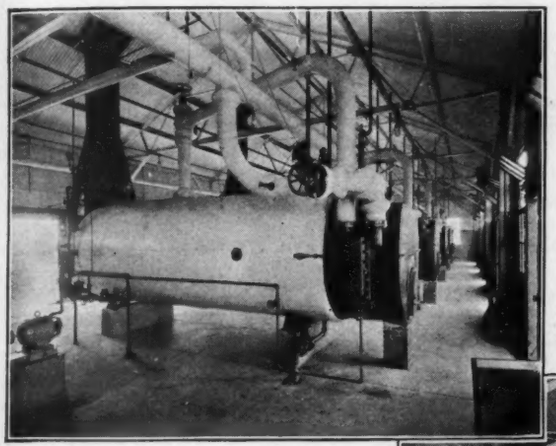
Following the opening of the Cities Service Gas Company's new 20-inch pipe line from the Texas Panhandle fields to Kansas City, the Standard Oil Company of Indiana has signed a contract with the Kansas City Gas Company for a minimum of 6,000,000 cubic feet of gas daily for use in its refineries at Sugar Creek, Missouri. After the signing of the contract in February approximately four miles of 24-inch pipe was ordered by the gas company for the purpose of connecting up the Sugar Creek refineries with the present end of the main in Kansas City.

The World's Largest Natural Gasoline Plant Uses Johns-Manville Insulation Throughout

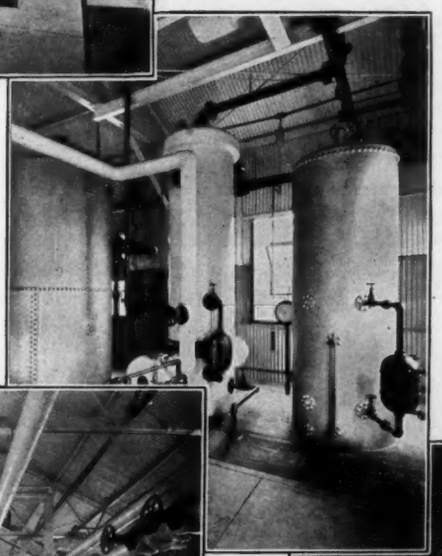
IT is a source of great satisfaction to us that when the Sinclair Oil Company planned the world's largest Natural Gasoline and Gas Lift Plant, Johns-Manville Insulation was specified throughout.

The accompanying pictures show several interesting examples of the use of Johns-Manville pipe and boiler insulations in this great gasoline plant.

Johns-Manville products are in use by the oil industry in all parts of the world.

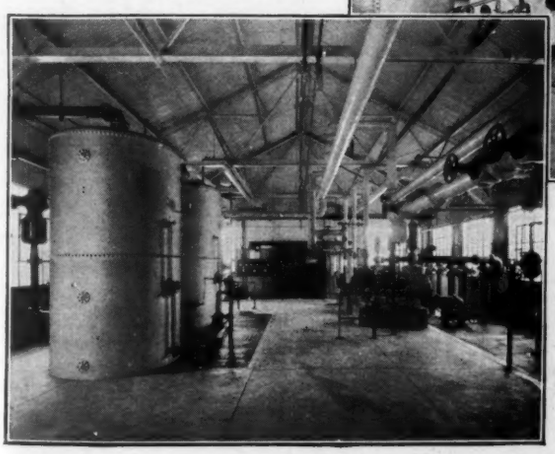


General view of boiler rooms showing Johns-Manville Insulation on boilers and steam lines



Johns-Manville Insulation on re-run still

General view of control house showing Johns-Manville insulation on steam lines



Johns-Manville Insulation on steam lines to pumps

OIL INDUSTRY DEPARTMENT

JOHNS-MANVILLE CORPORATION

New York Chicago Cleveland San Francisco

To Make Methyl Alcohol From Natural Gas

After extensive research and field tests in the Monroe gas field, the Louisiana Research Corporation has under construction at Swartz, Louisiana, a commercial type plant for the manufacture of alcohol from natural gas.

Field tests on the process in the Monroe area were completed in August, 1927. The definite demands of the process were satisfactorily determined through the operation, over an extended period, of a small scale unit. Following these experiments, which indicated satisfactory results, patents were applied for, and the plant under construction is designed to carry out the process on a commercial scale. The installation has a capacity of 250,000 cubic feet of gas daily.

The process is one to catalytically produce methyl alcohol from natural gas, and at the same time conditions of heat and pressure are productive of oil falling in the gasoline range of boiling points. Conversion is effected at proper temperature conditions of pressure and temperature in both steam and natural gas in the presence of a catalytic agent. Field tests which led to the construction of the cemmercial unit resulted in the yield of 2½ gallons of methyl alcohol and 2 gallons of oils per thousand cubic feet of gas passed through the system. High pressure equipment of special design is employed in the construction of the present unit.

The plant is attracting much attention in the field and has evoked much interest from natural gasoline manufacturers in the district. H. Alison Webster, chemical engineer, Columbia, Tenn., who perfected the process and conducted the field tests which resulted in the Louisiana State Conservation Commission setting aside sufficient gas for the operation of the commercial unit, is at Monroe, in charge of the present development work.

DUBBS UNITS FOR ITALY

Further information relative the entrance of the Italian government into the refining of gasoline, through an agreement with the Societa Benzina Italiana, is disclosed in a recent foreign letter appearing in Industrial and Engineering Chemistry, by Raffaele Sansome. Excerpting from Mr. Sansome's letter, we read:

"A decree was issued last November conceding a reduction in customs and internal revenue taxes to the firms that utilize residues from petroleum refineries. The object of this provision is to favor the production of light hydrocarbons in Italy by special methods of treatment. The state will participate in the administration of this industry, and thereby influence its development and encourage initiative.

"Lately an agreement was signed between the state administration and the Societa Benzina Italiana for the establishment of a plant by the latter in the industrial zone of Naples for the production of benzene by the Dubbs cracking process, utilizing the residues from the petroleum refineries."

GASOLINE PLANT AT MAUD

Gillespie & Moren, Inc., at Maud, Oklahoma, in Pottawatomie County, of the Greater Seminole area, are building a new natural gasoline plant. The location is in the southwest of the northeast of section 15-7-4. Plant capacity is to be 20,000,000 cubic feet of gas daily.

DISMANTLING NEWTON PLANT

The Southwestern Engineering Corporation, which recently purchased the Newton Process Manufacturing Company, manufacturers of the Newton Process equipment for natural gasoline extraction, is dismantling the Newton plant at Fullerton, California, and moving the equipment to Southwestern's main factory headquarters in Vernon, California.

ENLARGE PLANT

The Bluebonnet Refining Company's plant at Wickett, Texas, is being enlarged to 4000 barrels capacity. The additions to the plant include a pipe-still, condensers and exchangers. The company has also made arrangements with the newly organized Wickett Refining Company for the latter to purchase the tops and finish these into gasoline, kerosene, and gas oil, to be marketed locally.

CALIFORNIA OILS ANALYZED

Washington.—In serial 2846 issued by the United States Bureau of Mines, the physical and chemical properties of crude oil of various California fields are discussed. The paper deals largely with oil produced in the southern coast district, particularly in Ventura, Los Angeles and Orange Counties. These oils were found to be mostly of intermediate base, and to small extent of napthenic base.

PANHANDLE BUYS BUILDING

Panhandle Oil & Refining Company, Wichita Falls, Texas, recently purchased a half interest in the Culbertson Building, located at the corner of Travis and Seventh Streets, and has moved its general offices to the new address. The two top floors were reconditionsd for housing the company's offices.

Even after three years of service on a boiler feed pump, 200 lbs. pressure, 200 to 215°F., the metal bar of these "V" Pilot Packing rings is still intact.

Are You Getting This Service From Packing?

NOTE the excellent condition of this "V" Pilot Packing, which has served three years on a boiler feed pump, operating practically 24 hours daily, at temperatures of 200-215° F., against pressure of 200 lbs.

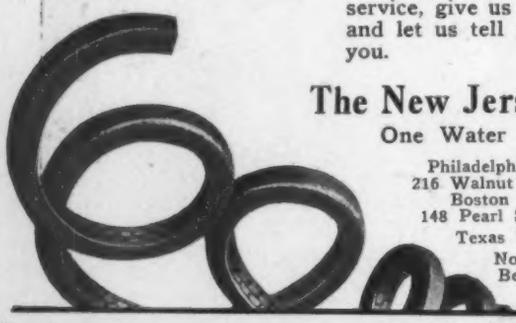
Such superior service from "V" Pilot Packing is assured by patented "V" Pilot construction. The continuous solid "V"-shaped flexible bar, with a resilient asbestos back, forms a perfect seal on the rod.

Whatever the packing service—water, air, steam, oil, ammonia, gasoline—"V" Pilot can be used to advantage.

If you are interested in improving packing service, give us an outline of your conditions, and let us tell you how "V" Pilot can serve you.

The New Jersey Asbestos Company
One Water Street, New York, N. Y.

Philadelphia, 216 Walnut St. — Baltimore, 17 So. Gay St. — San Francisco, 37 Spear St.
Boston, 148 Pearl St. — Norfolk, 111 E. Main St. — Wilmington, Cal., 236 Avalon Blvd.
Texas Rubber Specialty Co., Houston, Texas
Norvell Wilder Hardware Company, Beaumont, Fort Worth, Shreveport



"V" PILOT PACKING

Car Leasing Is Sound

Business Sense

The best indication of the economy and business sense of car leasing is the number of large shippers who lease all or part of their special car requirements.

Well able, if they desired, to operate their own fleets, they find it more profitable to stick to specialization—directing their capital and energies to the furtherance of their own business and leaving to the car lessor the outlay of capital, the task of keeping cars modern and well conditioned and the expense of interest, taxes, depreciation and obsolescence.

Yet these shippers exercise practically the same control over their cars as if they owned them, with the added advantage of being able, without capital investment, to add to the fleet as requirements dictate—and at a cost which, being fixed, may be definitely provided for in their budgets.

North American Car Corporation leases not merely tank, refrigerator and Palace poultry cars but *unusually well designed* cars which in addition to effecting practical economies, reflect credit on the shipper. This service is supplemented by a number of other services that you, as a shipper, should know about. Your inquiry will receive prompt attention.

Car Shops
Chicago, Ill.
Tulsa, Okla.
Blue Island, Ill.
North Judson, Ind.
Coffeyville, Kans.

North American Car CORPORATION

Executive Offices: CHICAGO, ILL.
Bulk Storage: Chicago, Ill., Tulsa, Oklahoma

Export Terminals:
New Orleans, La.
Galveston, Texas
Aransas Pass

Mention Where You Saw the Advertisement

BUILD AT LONG BEACH

Edington - Witz Refining Company, 516 Roosevelt Building, Los Angeles, recently took over the old Wadoline Refining plant at 2848 Cherry Avenue, Long Beach, California, and has rebuilt the plant. The new skimming plant has a capacity of 3000 barrels daily, and is producing gasoline, kerosene, gas oil and fuel oil.

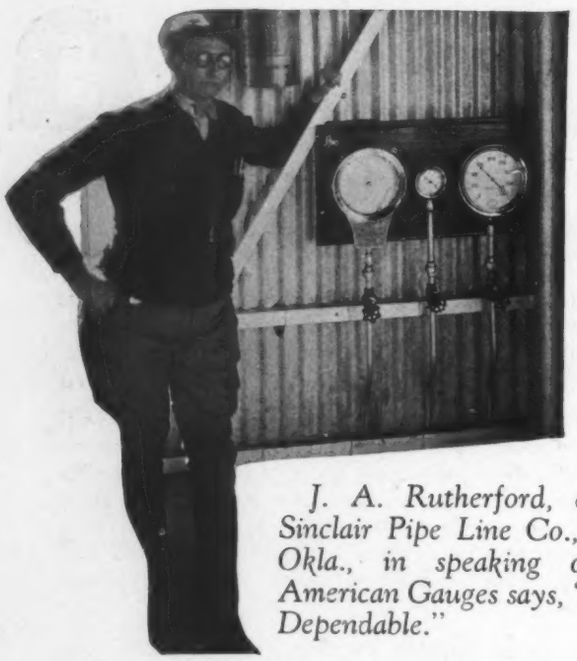
Design, construction and engineering service was handled by Southwestern Engineering Corporation, which furnished the equipment, including tube stills, boilers, fractionating columns with control sections, vapor condensors, coolers and heat exchangers. Specification products are produced direct without redistillation.

Officers of the new company are C. B. Eddington, president; H. J. Witz, vice-president in charge of refining, and W. E. Snowden is refinery superintendent.

START COMPRESSOR PLANT

Tulsa.—The Sinclair Oil & Gas Company recently started operating a compressor plant in the Little River pool, on its Cosar lease in the northwest of the northwest of section 36-8-6. The plant has an output of about 10,000 gallons of natural gasoline, and furnishes gas for use in gas lift in the Sinclair wells.

"They're dependable"



J. A. Rutherford, engineer, Sinclair Pipe Line Co., Stroud, Okla., in speaking of these American Gauges says, "They're Dependable."

The engineer prefers American Gauges and Thermometers because he knows he can rely upon their long service and constant accuracy.

Write for the following:

Gauge Catalog A-19
Recording Gauge Catalog E19
Thermometer Catalog F-19
Dial Thermometer Catalog G-19
Recording Thermometer Catalog H-19
Temperature Controller Catalog R-19
Steam Trap Catalog S-19
Tachometer Catalog J-19

AMERICAN INSTRUMENTS

American Schaeffer & Budenberg Corporation

338 Berry St., Brooklyn, N. Y.

BRANCHES IN PRINCIPAL CITIES

Makers of American Industrial Instruments since 1851

VACUUM COMPOUNDING PLANT

Plans for the construction of a new addition to Vacuum Oil Company's refinery at Paulsboro, New Jersey, have been approved. The addition consists of a three story, re-inforced-concrete structure, which will be equipped primarily for compounding service and wax production. It is estimated to cost about $85,000 with equipment. Contract for the building only has been let to White Construction Company, Philadelphia.

INGLESIDE SUIT SETTLED

Houston.—Humble Oil & Refining Company has resumed work on its refinery at Ingleside, Texas, near Corpus Christi, following a court decision in the case of the State versus the company permitting the latter to proceed with its project of building a pipe line across Corpus Christi Bay to deepwater loading racks. The construction of the refinery was temporarily held up pending the outcome of the suit, as Humble did not wish to complete the plant if adequate shipping facilities were not available.

REFINERY TO RESUME

The California Petroleum Corporation, which now controls the Arctic Refinery at North Lethbridge, Alberta, plans to resume operations at the Canadian plant, following the recent measure of the Dominion government providing for duty-free admission of "tops" for use in Canadian refineries.

REBUILDING AT SAPULPA

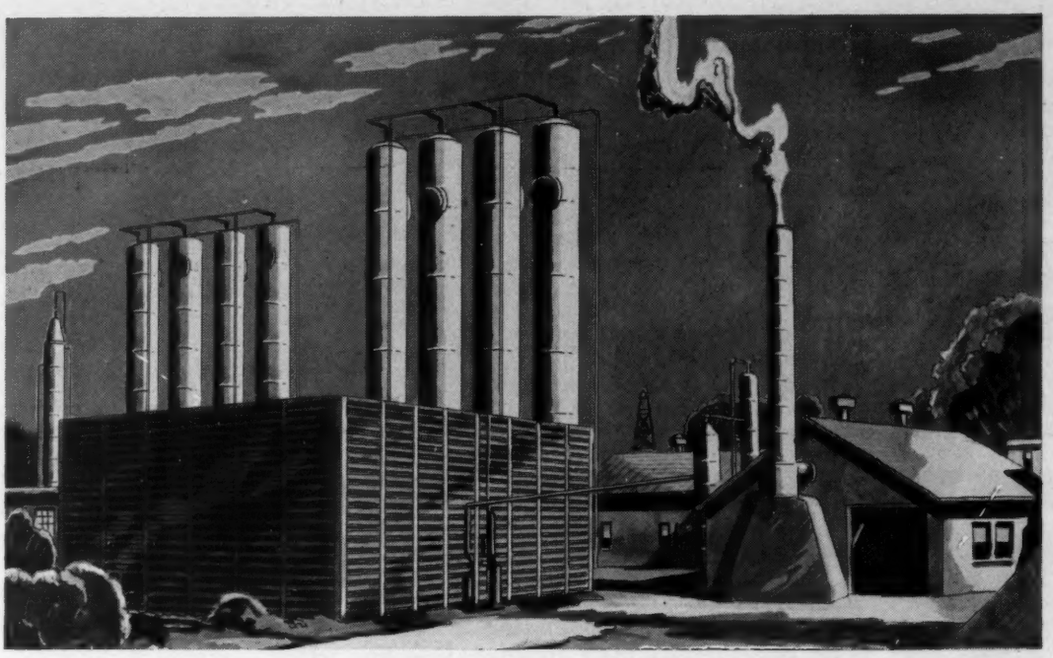
Continental Oil Company plans to rebuild that portion of its Sapulpa, Oklahoma plant which was recently destoryed by fire. Plans for reconstruction are now under way. The estimated cost of reconstruction is $200,000. The plant is operating.

NEW TYPE ABSORBER USED

In place of 12 5x40 foot absorbers, the Skelly Oil Company has installed a Campbell froth type absorber at its Lyman, Texas, plant. This is the first equipment of the kind that has been installed in the Mid - Continent field. Considerable saving in costs is being effected with the new absorber, largely through the elimination of one of the pumps used in circulating the oil.

RESUMES AFTER FIRE

Amarillo Producers & Refiners Corporation has completed the repair work made necessary on its refinery at Borger, Texas, by the fire occurring there in January. New fractionating equipment has been installed which has effected a material increase in gasoline yield through the skimming operation. The plant processes from 1200 to 1400 barrels of crude daily.



The Value of Experience

A simple a thing as a regulation base ball requires feel before the spring training squad gets into serious practice.

A new car, rolling for the first time off the freight platform, is stiff and slow to the touch of the throttle. Sometimes weeks of running are required to loosen up the kinks.

A production problem, no matter how closely it ties with the work of the plant, does not acquire its greatest efficiency till experience has taught the best and the easiest way.

No amount of study and willingness to do will compensate for the value of actual experience. The plant that has performed in the past is the plant most likely to perform efficiently at the present.

Wyatts, with actual experience in the work of supplying refineries, offers to refiners and natural gasoline manufacturers a trained organization ready for instant service.

Oil Tanks, Storage Tanks, Culverts, Smoke Stacks, Metal Products of all kinds.
Refineries Complete.

Wyatt Metal & Boiler Works

Dallas, Texas

BUILD FRENCH PLANTS

Inasmuch as the French oil importation bill as finally passed by parliament provides reduced duties on crude oil imported, the Standard Oil Company, Royal Dutch Shell and Anglo-Persian intend, it is reported, to build refineries along the French Seaboard. It is reported also that a refinery will be built at Marseilles by Compagnie des Petroles, which holds the French share of Turkish Petroleum.

PLANS FOR REFINERY

Southwestern Engineering Corporation prepared detailed specifications for complete refinery unit under construction by the Los Angeles-Pacific Refining Company, which organization has leased the old Brownmoor Oil Company's refinery at Signal Hill, Long Beach, for a period of five years.

J. A. Campbell, natural gas engineer, Long Beach, California, has arranged with Stearns Roger Manufacturing Company of Denver, Colorado, for representation in the Mid-Continent area. The Denver firm, which has charge of installation and sales work for Campbell Oil Froth absorption gasoline plant equipment, has opened offices at 938 Kennedy Building, Tulsa. Mr. Campbell will have general supervision of installations and will spend much of his time in the Mid-Continent area in that connection.

Leaders in the Industry
TEXACO
FREEDOM
QUALITY-SERVICE-ECONOMY
GALENA-SIGNAL OIL CO.
Waverly
ALL PENNSYLVANIA
RED CROWN
GASOLINE
SINCLAIR
OILS
GULF
The most prominent oil concerns appreciate the value of Power Piping Company service. We have a record of many satisfactory installations in refineries of companies whose marks are shown above.
We design, assemble and erect complete equipment or fabricate individual parts of refinery apparatus. We assure you a service backed by specialized experience in this field.
Power Piping
FOR EVERY OIL FIELD NEED
POWER PIPING CO. • PITTSBURGH, PA.

ENLARGE GASOLINE PLANT

The Texas Company is enlarging its compression and absorption type gasoline extraction plant at Pine Island, Louisiana. Two units are being installed in the compression plant of the low pressure type which will increase the supply of gas going to the gasoline absorption plant, increasing the number of compression units to six. The four units formerly in service were utilized in the operation of the company's gas lift system at Pine Island. The additional low pressure gas will effect an increase in gasoline recovery from the absorption plant, which produces from 6000 to 9000 gallons of gasoline daily. Gas through-put is reported at 20,000,000 cubic feet daily.

BEACON OIL REBUILDING

Arrangements are being made by the Beacon Oil Company, Everett, Massachusetts, for the rebuilding of that portion of its refinery which was recently destroyed by fire, with loss reported at more than $70,000.

WEST TEXAS REFINERY

Tulsa.—A 2500-barrel capacity skimming plant will be built by the Imperial Refining Company interests at Wickett, Ward County, Texas, and will be in operation by May 1, according to expectations. The plant will operate under the name Wickett Refining Company. The town of Wickett is about the same distance from the Winkler and Crane County pools, and is on the Texas & Pacific Railroad.

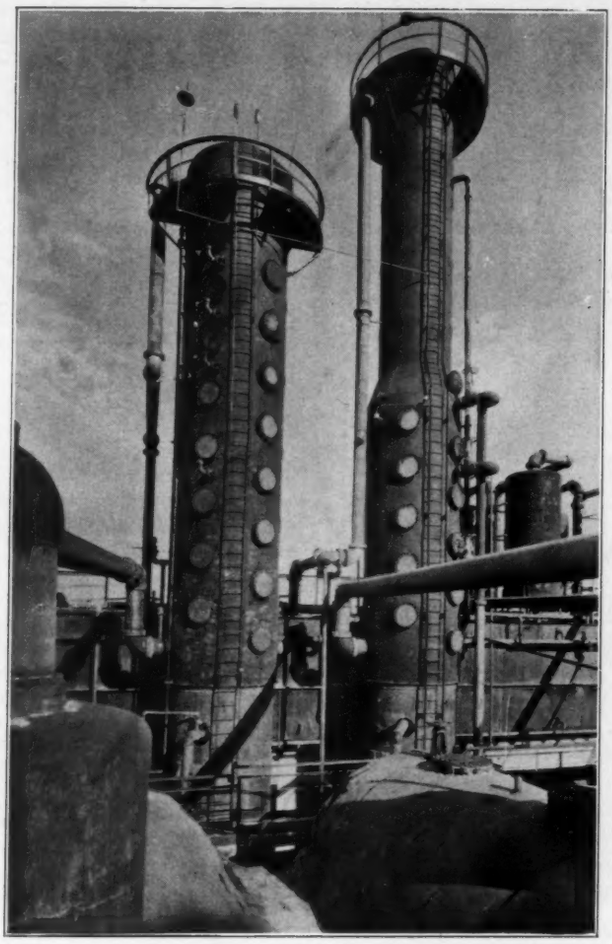
Officers of the company which will operate the plant are: C. R. Armstrong, Lock Haven, Pennsylvania, president; J. T. Withers, Jr., Dallas, vice-president; M. B. Woodley, Dallas, secretary; W. B. Hassett, Tulsa, treasurer and general manager.

According to recent reports, Pennzoil Company has stopped operating its battery of four Flemming cracking units at its plant No. 2 at Rousville, Pennsylvania, after several years of operation. The new installation of two Dubbs cracking units at the same plant has been completed, and they are in operation.

ROXANA GASOLINE PLANT

Roxana Petroleum Corporation is having preliminary plans made for a natural gasoline plant, absorption type, which is to be erected near Marshal, Oklahoma. The new plant will have a capacity of 60,000 gallons daily, and its estimated cost is to be $100,000.

C. M. Johnson, formerly with the Independent Oil & Gas Company at Okmulgee, Oklahoma, is now superintendent of plant operations for the Crown Central Petroleum Corporation at Houston, Texas. Mr. Johnson succeeds R. Q. Traweek, recently resigned.



Bubble Towers

for

PIPE STILLS

COKE STILLS

SHELL STILLS

STEAM STILLS

CRUDE STILLS

RE-RUN STILLS

CRACKING PLANTS

SPECIAL PURPOSES

STRIPPING COLUMNS

NATURAL GASOLINE ABSORBERS

The fractionating equipment offered is the result of years of research work and the experience gained in several hundred commercial installations.

The WINKLER-KOCH ENGINEERING CO.

Consulting and Construction Engineers

429 FIRST NATIONAL BANK BLDG.

WICHITA KANSAS

Many Plants Proposed for West Texas

(Continued from page 110)

plants at Dublin, Texas, and El Dorado, Arkansas. Headquarters of the Wickett Refining Company are located in the Magnolia Building, Dallas, Texas, and the officers of the company follow:

C. R. Armstrong, Philadelphia, president.

John T. Withers, Jr., vice president.

W. B. Hassett, San Angelo, treasurer and general manager.

B. L. Woolley, Dallas, secretary.

Jack Reardon, formerly with Imperial Refining Company at Ardmore, Oklahoma, is superintendent in charge.

Jules and Engene Constantin, who have been identified with the refining business in Oklahoma and North Texas for a number of years, are starting a 3000 barrel daily capacity skimming plant at Pyote, having contracted for a crude supply from The Texon Oil & Land Company. This plant will probably be known as the Tonkawa Refining Company.

Joe and Louis Olsen of El Dorado, Arkansas, are contemplating the erection of a 3000 barrel daily capacity skimming plant at Pyote, or at Wickett, and are now negotiating for equipment salvaged from a recently dismantled plant in Central-West Texas. J. D. Wrather, president of the Amarillo Producers & Refiners Corporation, which is operating a skimming plant at Borger, Texas, has contracted for a minimum of 1000 and a maximum of 1500 barrels of Hendrick field crude to be delivered at a fixed price over the next two years. A 1500 barrel plant at Pyote is being proposed by Wrather and associates.

The Odessa Refining Company has completed a small skimming plant at Odessa, and will depend upon tank car deliveries of crude from West Texas fields for its supply. Harry A. Wier, 505 Melba Building, Dallas, is president and general manager of this concern. The Big Lake Refining Company has arranged for a 20-acre site at Big Lake through the Chamber of Commerce, which also contributed a cash bonus of $5000 along with the site, and plans are to erect a 1000 barrel daily capacity plant. Roy McKee, Tulsa, is president of the concern, and E. B. McKee, San Angelo, is vice president.

Will Boost Runs

The Blue Bonnett Oil Refining Company, which has been operating a topping plant at Wickett since the first week in January, 1928, is installing heat exchangers and hot oil pumps to boost its crude charges to 4000 barrels daily. This plant is handling 3500 barrels of Hendrick field crude daily, and is only turning out fuel oil and tops. The fuel oil is being sold to railroads and industrial plants, while the tops are being delivered to plants at Grand Prairie, Sweetwater and El Paso. This is the first plant to be erected near the Hendrick field, and is protected on its crude supply through a contract made late in 1927 with the Southern Crude Oil Purchasing Company, which is delivering the crude to the plant. Headquarters of the Blue Bonnett Oil Refining Company are located in the Magnolia Building, Dallas, with the following officers:

John T. Withers, Jr., president.

B. L. Woolley, secretary-treasurer.

I. B. Chittenden, plant superintendent.

The Pecos Valley Refining Company is operating a 2500 barrel daily capacity skimming plant at Pyote, and is marketing most of its refined products locally, although long time contracts have been made on fuel oil and distillates with Middle Western consumers. Engene Griswold, formerly engaged in the refining business at Wichita Falls, is president of the Pecos Valley Refining Company. The crude supply for this plant is from the Hendrick field through a contract made with the Texon Oil & Land Company, which delivers the crude to the plant at 65 cents per barrel.

Other West Texas plants being operated by Humble, Col-Tex Refining Company, Rio Grande Oil Company, San Angelo Refining Company and the Sweetwater Refining Company have been in use for a long period.

The Motor Fuel Products Company, 408 Sames-Moore Building, Laredo, Texas, has started construction work on a 1750 barrel daily capacity refinery at Laredo, and is scheduled to start running crude about August 1, 1928. S. P. Coblentz is president and general manager, and other officials include: E. A. Sterling, vice president, and J. F. Lynch, secretary-treasurer. The Graver Corporation has contracted to erect this plant, which will cost approximately $300,000. It will be equipped with the Jenkins cracking process, using one 1750 barrel capacity still. Two 16 ton Gray treating towers will be used in connection with the cracking process.

Which is your Way?

If you have not awakened to the advantages of **automatic** temperature control, you must admit that your old-fashioned method is inefficient and costly. Constantly reading thermometers and then running around to adjust valves not only wastes time, but rarely maintains the exact temperature required, **except for short periods.** And when you forget to regulate temperature for an hour or so, production and quality suffer even if goods are not **totally ruined!**

Install a SARCO Temperature Regulator on 30 days' FREE TRIAL, for any temperature from 30° to 300° F., and then forget it. The Sarco will maintain any given temperature without further attention. This modern Regulator is entirely automatic. It can't forget, can't make mistakes.

Requires no outside attachments or operating medium. Is inexpensive to buy and to install. Has nothing to get out of order.

Order a SARCO Temperature Regulator today. If it doesn't prove its case in 30 days, return it and don't pay us a cent.

Booklet S-100 sent upon request.

SARCO CO., Inc.

183 Madison Ave., New York City

Boston Buffalo Chicago Cleveland Detroit Philadelphia Pittsburgh and St. Louis Peacock Bros., Ltd., Montreal

SARCO Temperature Regulator

TRANSIT PUMPS

Figure No. 1700 is a very popular type in the smaller refineries.

Fig. No. 1700

Our name TRANSIT, is a guarantee now just as it has always been for the past forty years.

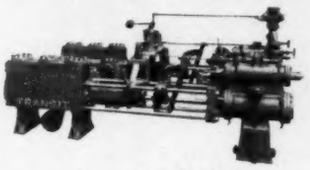


Fig. No. 1791

Real, honest-to-goodness, forged steel cylinders on all types.

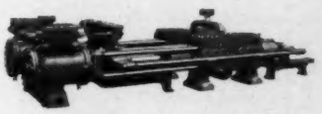


Fig. No. 1733

Heavy, cast iron, flanged steam cylinder piping and real brass globe valves.

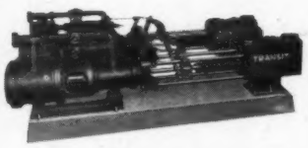


Fig. No. 1571

Oil in exact quantities, is delivered per minute, per hour and per day by TRANSIT Hot Oil PUMPS.

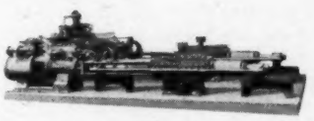


Fig. No. 1805

The discharge from any of these pumps is steady and constant.

Fig. No. 1792

Our hot oil pumps are absolutely safe in operation, both to life and property.

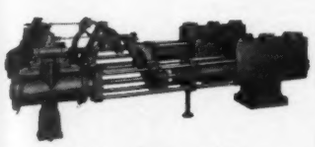


Fig. No. 1725

Illustrated descriptive matter on any type or Fig. No. furnished promptly.

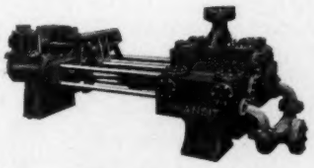


Fig. No. 1731

Long stroke pumps are long lived.

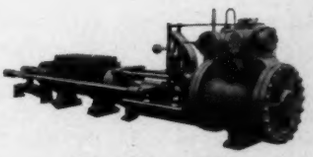


Fig. No. 1680

Representatives

FRICK-REID SUPPLY COMPANY
Tulsa, Okla., or any store.

ASSOCIATED SUPPLY COMPANY
Los Angeles, San Francisco, Bakersfield, Fellows

E. L. WILSON HARDWARE CO.
Beaumont, Texas.

NATIONAL TRANSIT
Pump & Machine Co.
Oil City Pa.

DISTRICT OFFICES
NEW YORK PHILADELPHIA PITTSBURGH
CLEVELAND HOUSTON TULSA DENVER

Representatives

THE GLOBE SUPPLY & MACHINERY CO.
New Orleans, La.

F. C. RICHMOND MACHINERY CO.
Salt Lake City, Utah.

NORTON McL. DUKEHART & CO.
Baltimore, Md.

REEVES & SKINNER MACHINERY CO.
St. Louis, Mo.

Abstracts of Technical Literature

Of Particular Interest to the Plant Operator

Natural Gasoline Industry

A Method of Fractionating Natural Gasoline. Keyes. (*Chem. and Met. Eng., Vol. 35, No. 2, p. 92*). Figure 1 represents a flow-sheet of the general process, which assumes an absorption process with steam as a heating medium, although the oil from the bottom of the columns could be made to pass into a still and the vapors returned to the column, or other indirect heating means could be used, if desired. The preheated oil containing the gasoline and the gases enter at the left and pass into a stripping column, from the bottom of which pure absorbing oil and water are withdrawn. The oil is cooled and separated from the water and returned to the system. The vapors from this column consist of all the gases, all of the product, and a little of the absorbing oil. The first condenser is run warm. Part of this condensate is returned as reflux and part sent on to the fractionation column 2. The second condenser is a cold or total condenser. The condensate, which probably has a different composition than the other, passes on to a separate fractionating column. It is quite possible to use one fractionating column instead of two as described. The two feeds will, however, enter at different points if they differ in composition. These fractionating columns act in the customary manner. The product containing a little too much absorbing oil (for the correct end point) is cooled and separated from the water and passed to a storage tank 4. The uncondensed gases from the condensers containing some valuable butane and pentane are sent to the compressors, coolers and water separators 5 along with the uncondensed gas from the condensers on the stripping column. A second absorption in the absorbing column 6 then takes place. A lower boiling absorbing oil is used in this case. The unabsorbed gases are sent back to the line. The gas-oil solution is stipped again in the stipping column 7 and the pure absorbing oil returned to the absorber. The crude product is refined in the fractionating column 8. The nearly pure product is sent to the storage tank 4 and the uncondensed gas from the condenser goes back to the line. The product in the first storage tank 4 will meet the specifications except in perhaps one respect, too high an end point. This is due to the presence of a small amount of absorbing oil, which can be removed as tails in the fractionating column 9. The uncondensed gases go back to compressors, coolers, etc. A fairly large amount of steam will be used in this column as the bulk of the material is distilled. The reverse is true in all other fractionating columns shown. The distillate is cooled, separated from the water, and sent to the storage tank 10. Stated briefly, this method of refining consists of stipping and fractionation; the heads are re-compressed, absorbed, stripped and fractionated; the tails are fractionated further to remove any undesirbale high-boiling oil. In the article is also illustrated with a flow-sheet and described a simpler and probably less efficient process.

Factors in the Design of Heat-Transmission Equipment (with particular reference to natural gasoline plants). Lewis. (*Chem. and Met. Eng., Vol. 34, No. 12, pp. 735-36*). Heretofore, design of heat-transmission equipment for natural-gasoline plants has been based largely on empirical rules, applicable only under limited conditions, a condition that has been particularly unfortunate wherever the designer is anxious to get the best possible correlation of plant elements from the point of view of economic balance. In this paper, Lewis calls attention to certain factors that have recently come to light in other industrial fields and which, undoubtedly, play an important part in natural gasoline technique. These factors relate to condensation of a gas before the gas as a whole has been cooled down to its dew-point; heat transmitted through a gas film represents only the sensible heat of the gas and does not include the heat of condensation of the vapor; while condensation is occurring, the thickness of the liquid film and therefore its thermal conductivity does not vary much with the amount of the condensation; and the influence of heat transmission on liquid friction, that is, on the pressure drop through pipes and conducts.

Refinery Processing

Dry-Refining Rumanian Oils—(*Nobel. Petr. Zeitschr., Nov. 10, 1927, p. 1399. Libr. Bull., U. O. P. Co., Vol. 2, No. 48, pp. 429-30.*) — Dry-refining Rumanian crudes has been impracticable hitherto. The lubricating oil distillates contain 0.3 to 0.5 per cent of naphthenic acids. These acids or the naphthene-sulfonic acids formed from them in the sulfuric acid treatment are not removed by bleaching earths, or only partly. The labile acid compounds left in the oil readily oxidize and polymerize, going over to dark-colored compounds in a few days' standing. The best method of removing these acids proved to be, to add an alkali to the acid-treated oil before or during distillation. Texas oils have been so treated for 10 years. In the Polish oil industry alkali is mixed with the oil to overcome the corrosive action of magnesium chloride. Among the patents on such processes is one for passing the distilled vapors through a mass of neutralizing material between the still and the condenser. In practice it is found advisable either to add concentrated caustic soda to the hot topped crude or to neutralize with a lime paste. The lime paste may be montejused into the oil in a preheater and the mixture stirred for some hours by the aid of a pump. With the lime pure and not used in excess, there is no danger that it will form deposits in the still. The quantity necessary will vary from 0.5 to 0.8 per cent of the crude. Most of the alkali is recovered as lime or sodium soap in the residuum. If this residuum is used as fuel the combustion gases contain sodium or calcium oxide and carbonate which deposit as a non-heat-conducting (but also non-corrosive and easily removed) layer upon the cooler portion of the pipes.

The asphalt produced from crude neutralized with lime is homogeneous, not even showing foreign matter under some

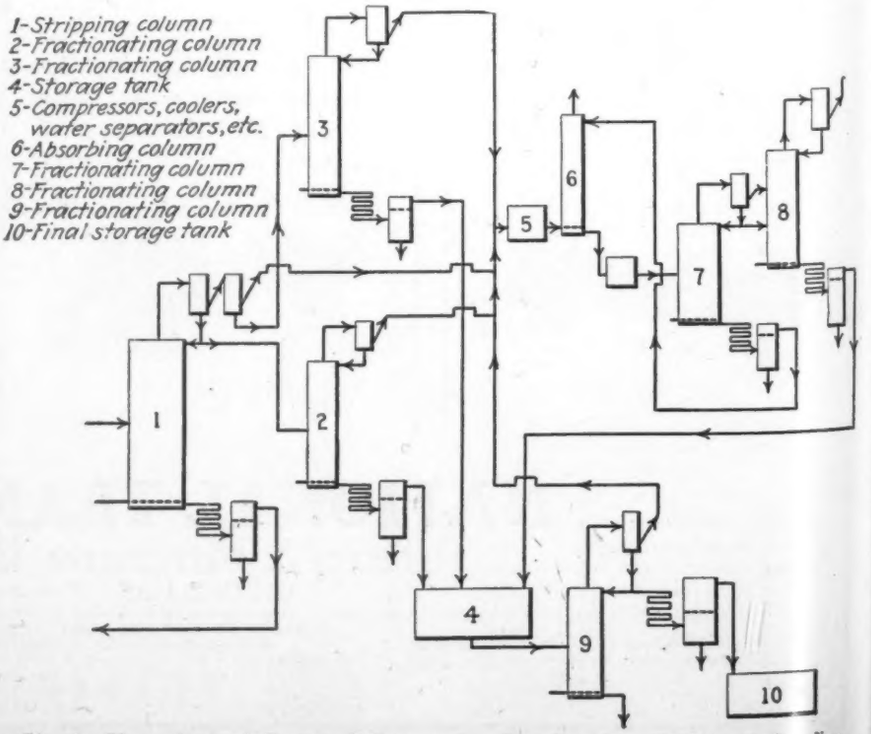
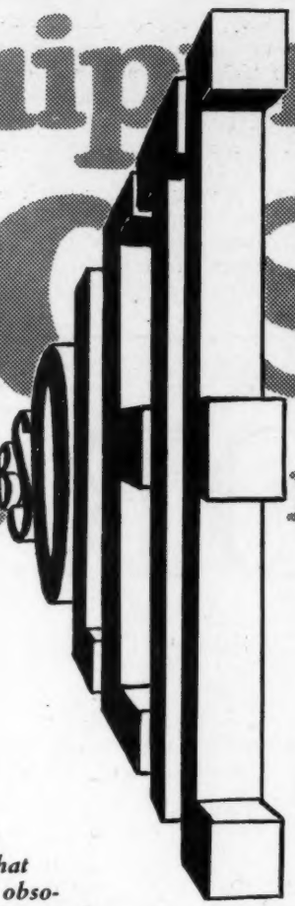


Fig. 1—Flow sheet of Proposed Process for Fractionation of Natural Gasoline

equipment costs you how much?



Are you using equipment that has become obsolete through time and improvements or are you installing equipment already proven obsolete or untried in design? TULSA-TYPE Equipment fills the increasing need of tomorrow, it costs no more and in many cases less.

With shops located in the very heart of the world's most active petroleum producing area, our engineers have the opportunity of *"on the ground"* experience. Varying needs can be studied with care and improvements closely watched under actual working conditions. The result is TULSA-TYPE Equipment embodying the latest improvements toward greater efficiency, flexibility and economy. Designed for plants yet on paper or adaptable to your present plant with minimum changes.

TULSA
Boiler & Machinery Co.
TULSA OKLAHOMA

magnification. Its ash content is from 2 to 6 per cent; benzol-insoluble, 2 to 5 per cent. It is somewhat more brittle than normal asphalt of the same hardness. It is ready to use for ordinary purposes and by oxidation becomes ductile. The softer of the asphalts containing caustic soda are viscous and would probably form a good base for asphalt emulsions.

The distillates are practically neutral. The acidity is always under 0.1 per cent SO_3, usually 0.02-0.03 per cent; as compared with 0.2-0.4 per cent in normal lubricating distillates.

With the worst emulsion-formers, the naphthene sulfonic and naphthenic acids, out of the way, wet-refining, that is, treating with caustic soda, requires from 30 to 60 per cent less caustic than normally; oil losses are smaller and the color of the product is incomparably better. Dry-refining only becomes possible by the removal of the naphthenic acids. Only 3-4 per cent of sulfuric acid is required instead of 8-9 per cent. It is added in two steps, and the last acid is carried down by adding a heavy, finely-powdered material like gypsum or coarse silicate. The acid losses are 15-35 per cent less in dry refining. The consumption of silicate is about 6-9 per cent of the distillate; and the oil losses in the silica treatment are at most 80 to 100 per cent of the quantity of silicate used. For lubricating oils the mixing method is better than the filtration method, requiring less outlay of equipment. On account of the high cost of bleaching earths (in Rumania) wet-refining is preferable for the lighter oils; but experiments are already under way looking toward bringing domestic silicates upon the market.

COLOR
YOUR
HIGH
COMPRESSION
GASOLINE

a distinctive color

Write us for samples of colors you wish to try

INTERSTATE
COLOR CO., Inc.
41 PARK ROW, NEW YORK

Distillation

Petroleum Distillation. Dunstan.—(*Industrial Chemist, Dec.* 1927, *pp.* 533-8.)—Illustrated account of the design and use of pipe and shell stills in petroleum refining. Curves showing the course of distillation in a bubble tower are given.

Cracking

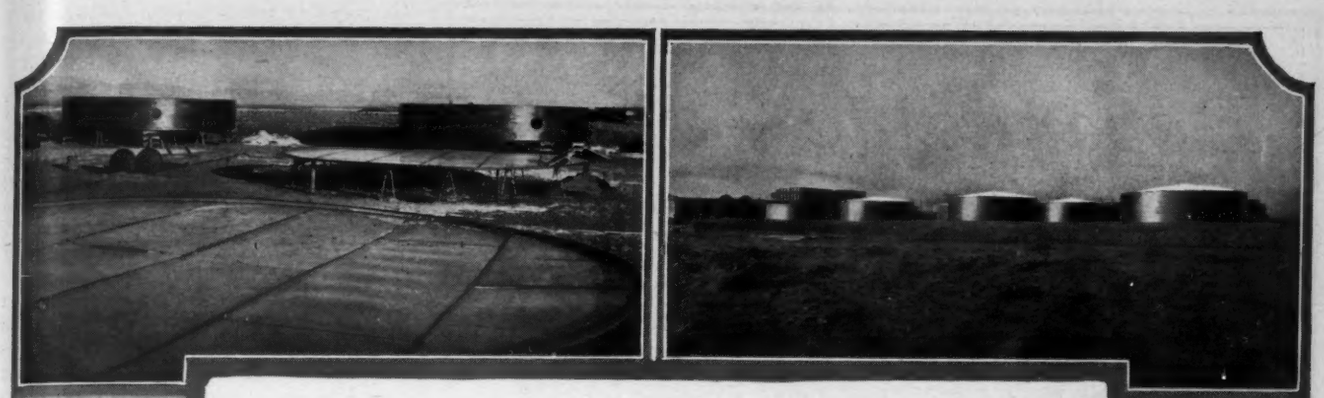
The Cracking of Heavy Petroleum Oils. (*Bourgom and Bourgois. Ing. Chim.*, 9, 89 (1925.) *Chem. Abs., June* 10, 1927, *p.* 1882.)—Discussion of the mechanism of cracking, with a description of cracking at atmospheric pressure and of the treatment of the products of this process, and particularly of the refining of the gasoline fraction to make it suitable as a substitute for straight-distillation gasolines.

Treating

Continuous Treatment of Light-Oil Products. Tzurikov.—(*Azerbeidjanskoye Neft. Khoz.* 1927, *No.* 8-9, 76-9, *C. A., Vol.* 22,*No.* 4, *p.* 680.)—A description of a plant for the continuous treatment of oils is given. The plant works on the counter-current principle. Air is entirely eliminated, losses through evaporation being avoided. All vessels are closed. The oil is pumped through the system, while the reagent flows by gravity. The apparatus consists of mixing and settling chambers. The main feature is the application of perforated lead cones for atomizing the oil in the acid medium, thus exposing a large surface of the oil toward the acid. Drawings and a complete description are given. This invention is covered by the Russian patent No. 15,565.

Reclaiming of "Black Kontact V" on a Manufacturing Scale. Vlaesenko.—(*Azerbeidj. Neft. Khoz.* 10, 86-8 (1927). *C. A. Vol.* 22, *No.* 3, *p.* 497.)—Sludge left from fuming acid treatment of vaseline oil is treated in a lead-lined kettle heated with steam coils. Seventy-five thousand six hundred pounds of acid sludge were added slowly in five lots, stirred with air for 15 minutes and allowed to settle for eight hours at 75 degrees C. The acid and water were drawn off, 3780 pounds of water were admitted, the mixture was agitated for 20 minutes at 85 degrees C., and allowed to settle for 12 hours. A third treatment with water showed only traces of acid. The total amount of acid separated amounted to 39 per cent, or 26-27 per cent monohydrate. Sixty per cent of sulfonate was reclaimed. The average strength of acid reclaimed was 67.75 per cent. It was mixed with 2½ volumes of fuming acid to give 92.5-93 per cent acid. This is an excellent agent for treating oil and gives a much better color than the fresh acid. The sulfo-acids are water-soluble.

Air Pressure at which Sulfuric Acid Cars Should be Unloaded. Tiley—(*Chem. and Met. Eng., Vol.* 35, *No.* 2, *p.* 110.)—Tank cars used for the transportation of sulfuric acid are subject to a test pressure of 60 pounds per square inch.



"The Sun Never Sets on Hamondtanks"

The "Copyrighted Slogan" tells the story.

In every country where Petroleum Products are stored in steel tanks Hammond Tanks are used.

Steel tanks in capacities up to 100,000 barrels; knocked down or erected.

Oil Refinery Equipment, Stills, Towers, Agitators, etc.

Send for—

Our Bulletin No. 300—Hammond Filters.
Our Bulletin No. 200—Storage Tanks.
Special Bulletin—Handling and Storing of Fuel Oil.

HAMMOND IRON WORKS

Warren, Pa., U. S. A.

New York Office: 17 BATTERY PLACE
Telephone: Whitehall 0060

Cable Address
"HAMONDTANK", Warren, Pa.

Dependable Valves for Acid Lines

ON sludge lines, at agitator outlets, in fact, wherever acid valves stick, leak and need continual repairs and replacements, Duriron Plunger Release Plug Valves may be depended upon to end these troubles, because—

1. *They are 100% acid-proof. Duriron is extremely resistant to acids and caustics used in refinery processes.*
2. *The extreme hardness of Duriron prevents scoring of the moving surfaces by gritty solids carried in solution, thus eliminating leakage through valves.*
3. *The plug may be freed in an instant when it sticks by tapping the release plunger with the wrench. Severe and continued pounding on plunger will not cause the valve to leak or squirt.*

This quick acting, safe and permanent valve is described in Duriron Bulletin No. 144-A. Send for it.

"Duriron in the Refinery," a booklet that describes the uses of Duriron pumps, valves, piping and special equipment for acid processes, mailed on request.

Duriron is produced only by

The DURIRON COMPANY
DAYTON·OHIO

SPECIFY Kerlow Gratings and Safety Steps For:

WALKWAYS
Boiler Room Floors
Turbine Room Floors

AREAWAYS
Fire Escapes
Platforms

SUBWAYS
Sidewalks
Trench Covers

Write for Catalogue F66E

KERLOW STEEL FLOORING COMPANY
220-224 CULVER AVE., JERSEY CITY, N. J.

The pressure for unloading contents from such cars is not officially authorized, although the use of air pressure for unloading purposes up to 30 pounds per square inch (one-half the test pressure of 60 pounds), is considered to be within the limits of safety. Upon an exhaustive investigation of the practice of unloading sulfuric acid tank cars by air pressure, the Tank Car Committee of the Manufacturing Chemists Association of the United States discovered the use of excessive pressures in certain localities. Since that time, an educational campaign has been in progress restricting the unloading pressure to 30 pounds per square inch, the use of pressures in excess having *not* been authorized and should never be used for unloading sulfuric acid acid tank cars.

Refrigeration

Corrosion in the Refrigerating Industry. Roberts, Forrest and Russell.—(Refrig. Eng., Vol. 14, *No.* 6, *Dec.* 1927, *pp.* 173-182 *and* 187.)—A. S. R. E. corrosion committee presents draft of its final report; corrosion of iron, steel and galvanized steel in brine systems may be greatly reduced by addition of sodium dichromate to brine; di-sodium phosphate as corrosion retarder; comparison of dichromate and phosphate treatments; other materials as retarders in brine; corrosion in condenser systems and in salt water; heat-transfer measurements for paint coatings and rust films; recommendations for treatments and instructions for application.

A Valve Marker for Ammonia Systhems.—(The Power Specialist, Feb. 1928, *p.* 9.)—The expedient of using string or wire to mark the extent to which an ammonia valve is opened proves quite as unsatisfactory as the grooved or embossed markers on the wheel itself. Any of these will cover up with frost in so short a time that the frost must be scraped away before the position of the valve can be determined. A means of marking that not only is unaffected by frost, but also can be read from a distance, consists of an L-shaped strip of iron fastened with U-bolts across the handwheel of the valve. When several valves are provided with markers, all should be closed and the markers applied at the same angle, so that the relative position of the valves can be seen at a glance.

Maintenance

Stopping Pipe Leaks.—(The Power Specialist. Feb., 1928. *p.* 9.)—The actual cost of making a repair is apt to be insignificant when compared to the cost of shutting down the plant, or a part thereof, in order that the repair may be made. For this reason temporary repairs are often justifiable, in order to tide over the period until a general shut-down for other causes makes permanent repairs possible. Leaks in direct radiation piping are an instance of this. When it would be costly to remove lengths of piping to make permanent repairs, temporary ones can be effected in this manner: A clamp two or three inches wide is made from iron sheet or strip, one-sixteenth-inch thickness being ample for most purposes. A piece of

at last! An Orifice Meter that tells the Truth

Foxboro New Orifice Meter used to measure gas at Sinclair Oil & Gas Company, Seminole

Think what it means to you to have an Orifice Meter with no inherent error. The new principle of Uniform Multiplication has been accomplished by Foxboro by means of a segmental lever. You have an absolutely uniform scale chart. An inch is an inch. No other orifice meter has this revolutionary improvement.

The records by which you buy or sell gas can now be accurate, not approximate. Office correction for variables is reduced to a minimum. Permanency of calibration and accuracy are built in at the factory. It's all there—right on the chart. There is no appeal from its verdict, no small hidden errors that may mean thousands of dollars to you.

To the man in the field, the sturdiness of the new Foxboro Orifice Meter makes a strong appeal. It is so easy to clean, so easy to assemble. After filling with mercury, a simple micrometer screw zeros the meter. A few drops more or less make no difference. Calibration is permanent. The size of the vital working parts is increased. The uniform pen travel is another way of saying uniform chart scale. The result is an amazing accuracy of performance that has never before been reached.

Foxboro will have an exhibit at Natural Gas Convention to be held in Dallas, Texas, during the week beginning May 7th, 1928

This new Foxboro Orifice meter has been thoroughly tested in the field. Hundreds are already in operation giving utmost satisfaction. It has not only established this revolutionary new standard of performance, but has preserved the reputation for reliability that characterizes any instrument bearing the name of "Foxboro." This meter has already been accepted by the engineers of the leading gas and oil companies throughout the country.

We suggest that you get in touch with our nearest branch office

The Foxboro Company

Neponset Avenue, Foxboro, Mass., U. S. A.
205 So. Cheyenne Avenue, Tulsa, Okla.

NEW YORK CHICAGO BOSTON PHILADELPHIA PITTSBURGH CLEVELAND ROCHESTER, N. Y. ATLANTA
LOS ANGELES SAN FRANCISCO PORTLAND, ORE., DETROIT

PEACOCK BROTHERS, *Limited*
1605 Delorimier Avenue
Montreal, Canada

Sole British Representatives:
WALKER-CROSWELLER & CO.
58 Queen Elizabeth Street
London, S. E.

FOXBORO

REG. U. S. PAT. OFF.

THE COMPASS OF INDUSTRY

Instruments for Indicating, Recording and Controlling Temperature, Pressure, Humidity and Flow

Texas Clay Products Co.,
Malakoff, Texas

Elgin Butler Brick Co.,
Austin, Texas

Acme Brick Co.,
Ft. Worth, Texas

Athens Brick & Tile Co.,
Athens, Texas

Refiners of the Southwest pay less

Quality Equal to 85% of Fire Brick Uses

A high quality fire brick with a low, local freight rate! That's why Refiners of the Southwest use Texas Fire Brick. Get the grade you require at the price you desire, use

TEXAS FIRE BRICK

[Other Economies: We often find customers using higher grade brick than is needed. Tell us your needs; it may be we can effect still greater economy for you.]

Write Any Member Listed

Texas Fire Brick Mfgrs. Assn.

Promoting Texas Fire Brick Economies

CRANDALL PACKINGS

Your Nearest Service Branch

New York, 109 Liberty Street
Boston, Mass., 147 Summer Street
Kansas City, Mo., 311 Coca Cola Bldg.
Philadelphia, Pa., 1004 Race St.
Chicago, 14 N. Franklin St.
Pittsburgh, Penn., 1217 Fulton Bldg.
Birmingham, Ala., 107 South 21st St.
Detroit, Mich., 406 Marquette Bldg.
Cleveland, Ohio, 1637 Superior Ave., N. E.
St. Louis, Mo., 707 Market St.

CRANDALL PACKING COMPANY
O. J. GARLOCK, PRES. & GEN. MGR.
PALMYRA, NEW YORK
No affiliation with any other concern selling the consumer

VALUE FIRST

Johns-Manville Service Sheet is then wrapped around the pipe at the leaky point and the clamp tightened until the leakage is stopped.

Corrosion

Chromium as a Corrosion Preventative. Wright.—(*Metal Industry, Vol.* 31, *No.* 25, *Dec.* 23, 1927, *pp.* 577-79.)—Early hopes for production of permanent corrosion-resistant coating of chromium have been hardly realized; failure of carefully-stored, chromium-plated brass articles in about fortnight forced author to conclusion that many factors, other than corrosion, were at work in causing break-down of chromium; it has become apparent that failure is not haphazard; discusses number of definite types of failure and attributes to each article definite cause for its break-down.

Boiler Plant Operation

Combustion Control Formulas. Uehling.—(*Power, Vol.* 67, *No.* 1, *Jan.* 3, 1928, *pp.* 12-14.)—Application of formulas to test data; heat-loss formulas; it is evident that per cent of CO_2 and CO, temperature of gas leaving boiler and square root of boiler draft are fundamental data required for intelligent and effective control of boiler operation.

Measurement and Regulation of Feed Water.—(*Power Plant Eng., Vol.* 32, *No.* 1, *Jan.* 1, 1928, *pp.* 32-33.)—Measurement of quantity of water is most accurately made by weighing it in tanks where quantity to be measured is not too large and short time determinations are not required; where it is desirable to have continuous observations, some form of meter is advisable; types of meters; feedwater regulators.

Circulating Water Supply Extremely Important.—(*Power Plant Eng., Vol.* 32, *No.* 1, *Jan.* 1, 1928, *pp.* 64-66.)—If natural supply is not available, spray pond must be provided entailing additional investment and auxiliary power; quantity of circulating water can be found from heat balance.

Tests of Raw Water Involve Many Processes.—(*Power Plant Eng., Vol.* 32, *No.* 1, *Jan.* 1, 1928, *pp.* 26-27.)—Following careful analysis of water, regular routine tests are made by power plant personnel and records kept. Tests should be made for following: total alkalinity, carbonate, bicarbonate and hydrate alkalinity, hydrogen-ion concentration, chlorides, dissolved oxygen, total solids, suspended solids, turbidity and total hardness.

Testing and Analysis

Apparatus for Determining the Softening Point of Paraffin and Other Waxes, Pitches, etc.—(*Herbst. Chem. Ztg.*, 51, 140 (1927). *B. C. A.-B., Apr.* 15, 1027, *p.* 244.)—A brass rod resting on the surface of the wax, etc., under test is attached to a balance weight by a thread passing over a fixed pulley, an indicator needle on the spindle of the latter recording on a dial any movements of the rod. The wax, contained in a securely clamped tube, is heated in a double heating bath, and ob-

PREVENT TANK EXPLOSIONS

by Painting Underside of Tank Roof with

RUBSHELL PAINT

which Prevents the
Formation of Sulphide of Iron during which

SPONTANEOUS COMBUSTION

May Take Place

SEND FOR RUBSHELL CIRCULAR TO

Sole Manufacturers

INTERNATIONAL COMPOSITIONS COMPANY

25 Broadway, New York City

Agent for Texas
J. A. ROSSITER CO., HOUSTON, TEXAS

Agent for Louisiana
WOODWARD, WIGHT & CO., LTD., NEW ORLEANS

Agent for California
C. G. CLINCH & CO., SAN FRANCISCO
AND SAN PEDRO

An Improved Ventilator for the Oil Industry

BUCKLEY'S Multi-Syphon Ventilators are in use by some of the most successful Refining Companies and manufacturers of Natural Gasoline in the United States and Foreign Countries.

Their stamp of approval is a guarantee to you.

Such Preference Must be Deserved

"BETTER VENTILATION AT LESS EXPENSE,"

which gives you full details as to construction, theory, material, capacities, weights and prices.

Write for catalogue.

Manufactured only by

The American Cornice Works Co.

Wichita, Kansas

McKim Metallic Asbestos Gaskets

COPPER

ALUMINUM

MONEL

ARMCO

Plain or Corrugated

Catalog No. 17 on Request

McCord Radiator & Mfg. Co.

Manufactures of McCord Force Feed Lubricators

DETROIT, MICH.

California—Chandler & Warden, 121 West Pico St., Los Angeles

The Spiral Motion Is the Trick

That's why Hood's Chemico Spiral Packing Rings have been selected by so many engineers. The center hole prevents choking and clogging.

Made of acid-resisting shale—practically indestructible.

Used by all big producers because of the intensive movements.

Samples on request.

B. MIFFLIN HOOD BRICK CO., Atlanta, Ga.

servations of the progressive softening can be made as the rod slowly sinks.

Determination of Water in Oils

(*H. Pflug. Chem.-Ztg.*, 1927, 51, 717-18: *B. C. A.-B, Nov.* 11, 1927, *pp.* 834-35.)—A modification of Oertel's method is described in which 25 g. of the oil are mixed with 10 g. of a mixture of two parts of anhydrous magnesium sulfate and one part of quartz powder in a heat-insulated apparatus of stated dimensions and the rise of temperature is observed. For rises of temperature up to 13 degrees, the radiation losses are practically uniform, and the percentages of water in oils of mean specific heat 0.5 g. g.-cal./g. may be calculated from the observed rise of temperature by means of a constant factor 0.6. When using an apparatus of different dimensions or when examining oils with appreciably different sp. heats, other factors are applicable. In the case of oils with a moisture content greater than 8 per cent, which give a rise of temperature of more than 13 degrees, a preliminary dilution with a known quantity of water-free oil is necessary.

Method of Determining the Acidity of Dark-Colored Petroleum Products.—(*Smirnof. Azerbaidj. Neft.-Chaz.*, 52, 66 1926.) *J. I. P. T., June,* 1927, *Abs. No.* 316.)—The method consists of adding to 10 gms. of the oil 50 c.c. of 0.5N alkali in alcoholic solution, shaking for 10 minutes, and then adding 300 c.c. of petroleum ether. The mixture now consists of two layers, a petroleum ether-oil layer on top, with the alcoholic solution below. The upper layer is washed with 80 per cent alcohol until the washings are neutral, and the lower layer is washed twice with petroleum ether. The washings of the alcoholic layer are added to the petroleum ether solution, while those from the latter are added to the alcohol solution. The alcohol is next distilled off from the alcoholic solution, and the residue taken up with 30 per cent sulphuric acid. The naphthenic acids liberated by the acid are extracted with ether, and the ether subsequently removed by distillation. The residue is now taken up with 200 c.c. of petroleum ether and 5 c.c of benzine, 400 c.c. of distilled water are added, and the solution titrated cold with 0.1N alkali with phenolphthalein as indicator.

The advantages of this method are, firstly, that the titration is carried out in the absence of easily oxidizable materials such as alcohol and ether; secondly, that the solution is colorless; thirdly, that the end-point color is stable, and lastly, that the extraction of acid is complete. The method suffers from the disadvantages of the titration being carried out in aqueous solution, and of the possibility of hydrolysis of naphthenic acids.

Comparison of Methods of Measuring Knock Characteristics of Fuels. Edgar.—(*J. S. A. E., Jan.*, 1928, *pp.* 41-48, *Instruments, Vol.* 1, *No.* 2, *p.* 18.)—Considerable divergencies are reported in the results obtained by different methods, particularly for certain fuels, although there is reasonable agreement for other fuels. No system of rating the knock characteristics of fuels is in use at present, by

Refinery Walkway

ARROWHEAD GRATING AND TREADS For the Oil Industry

Some of the largest Refining Companies in the United States are users of ARROWHEAD GRATING.

Open flooring in the Oil Industry is more important today than ever before as it is essential to the proper passage of light and air.

Owing to its non-slip quality, ARROWHEAD GRATING furnishes a perfectly safe footing, either interior or exterior.

ARROWHEAD TREADS are used extensively in Refinery construction.

They are strong, durable and safe.

Write for our catalog

ARROWHEAD IRON WORKS, Inc.
431 West Fifth Street Kansas City, Missouri

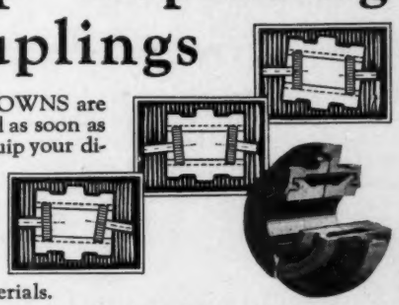
A Modern Publishing Establishment

Our equipment is especially adapted to the publishing of books on petroleum, oil field supply catalogues, oil company house organs, booklets, etc.

Give us an opportunity to figure on your next printing job

The Gulf Publishing Company
3301 *Buffalo Drive*
Houston, Texas

Stop Replacing Couplings



SHUT-DOWNS are avoided as soon as you equip your direct drives with Fast's flexible couplings, which are free from flexible materials.

Here is a coupling in which fatigue and failure are eliminated forever. No flexible materials are used. No bushings, pins, springs, discs, grids or any other flexible parts are used to compensate for misalignment.

Instead (see diagram above) two spur gears, one on each shaft end, are completely and continuously meshed in oil with the internal gears of a floating sleeve. The shafts and sleeve turn noiselessly as one unit, allowing free angular and lateral movement. No flexible material. Shut-downs for replacements are eliminated forever.

FAST'S COUPLING
—Self-Aligning—

THE BARTLETT HAYWARD CO.
200 Scott Street · BALTIMORE, MD.
Write today for free BOOK

which the results of different laboratories are readily comparable. An analysis of the data obtained from the nine laboratories is given, and possible reasons for the divergencies are discussed. In his general discussion of the results, Edgar points out that two distinct problems are involved in the data. The first is the rating of the fuels in terms of the quantity of tetra-ethyl lead needed to make the fuels to a standard better than they are. The second problem is the rating of the fuels themselves in terms of some other standard fuel to which an anti-knock or benzol has been added, or in some arbitrary system.

Determination of Lead Tetraethyl in Fuels.—(Ferreri. Gioon, Chim. Ind. e. appl., 7, 625 (1925). *Petr. Ztschr., June* 10, 1927, *p.* 699. *Libr. Bull., U. O. P. Co., Vol.* 2, *No.* 28, *p.* 219.)—In a 250-c.c. round-bottomed flask 50 c.c. of the fuel is heated under reflux. The hydrochloric acid penetrates the gasoline and after a time lead chloride suddenly crystallizes out. With longer boiling this is dissolved again. The gasoline is then distilled off, and the lead is determined as lead sulfate in the usual manner.

Determining the Congealing Point of Lubricating Oils. (Dietrich, Erdol u. Teer, March 31, 1927, *p.* 204. *Libr. Bull., U. O. P. Co., Vol.* 2, *No.* 18, *p.* 137.) The use of ether as a cooling agency is recommended instead of ice water or an ice- and salt mixture, because it does not interfere with visibility. The firm of Carl Stelling, Hamburg, makes an apparatus which provides for this form of cooling, with easy control of temperature drop.

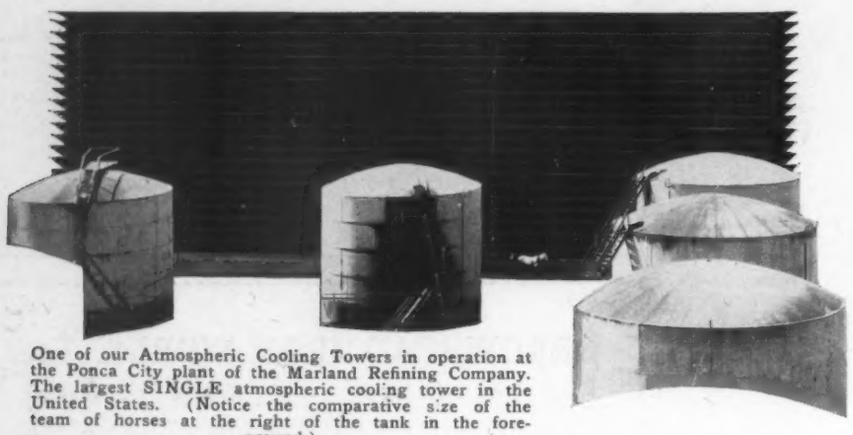
Manufacture of Specific Products

Manufacture of Light Concentrated Extracts of Sulfonic Acids from Vaseline Oil. (P. Montag, Azerbeidyanskoye. Neft. Khoz. 1927, *No.* 1, 48-51. *C. A. Nov.* 10, 1927, *p.* 3738). The reagent "Kontact" is a pitch-black to dark-blue, viscous liquid, with SO_2 odor. It contains over 40 per cent of sulfonic acids; mineral oil, 15 per cent; H_2SO_4 3 per cent. It is used in soap manufacture, and in the textile industry particularly for silks and woolens. In its manufacture vaseline oil is treated successfully four times with H_2SO_4, and 20 per cent SO_3, and the sulfonic acids are extracted with H_2O. The acid-treated oil is cooked each time to 15-20 degrees C. The first and second extractions are carried out with fresh H_2O, the third and fourth with extracts of acid from the first two extractions. The process is covered by Russian Patent No. 803,428.

New Uses

The Use of Kerosene as a Reducing Agent. (Petr. Times. Jan. 21, 1928, *p.* 118). H. Edwin Coley, Ltd., have been experimenting in the reduction of metallic oxides by carbon in its supposedly nascent state at the moment of cracking an oil. The idea has been applied commercially only to zinc and iron; but it is believed that it will prove useful in reducing many oxides and carbonates and in smelting some ores. There appears to be an optimum temperature for each metal. Zinc oxide is heated to a point between 1000 and 1200 degrees C. (1832-2192 degrees F.) in a revolving cylinder. The paraffin oil for cracking passes through the cylinder in a water-cooled pipe.

Computation Methods in Countercurrent Absorption Systems. Lewis and McAdams. (Ind. and Eng. Chem., Vol 20, *No.* 3, *pp.* 253-57). The research work of recent years on the interaction between gases and liquid solvents has thrown a flood of light on the mechanism of such reactions and has resulted, apparently, in substantially universal acceptance of the so-called two-film theory of diffusion. However, these research results have rendered obsolete the methods of computation hitherto accepted as standard in the design of commercial absorption units, except for certain special cases. The article presents graphical methods of design, based on present day theories, which are generally applicable. Furthermore, these methods are advantageous in that they lessen the labor of computation and make possible a clear visualization of the operating conditions in the unit and the influence of various important factors upon them.



One of our Atmospheric Cooling Towers in operation at the Ponca City plant of the Marland Refining Company. The largest SINGLE atmospheric cooling tower in the United States. (Notice the comparative size of the team of horses at the right of the tank in the foreground.)

When You Must Choose Between a Cooling Tower and Spray Pond

THE REFINERY ENGINEER must often choose between a cooling tower and a spray pond when it comes to installing water cooling equipment. For many years we have been manufacturing and installing both cooling towers and spray ponds for refineries and can advise you intelligently as to which is the best type for your purpose.

We have designed and built cooling towers and spray ponds for firms like Marland Refining Co., Union Oil Co., Roxana Petroleum Co., and others equally well known.

Write for Th se Bu letins

Bulletin 273-R. Cooling Towers.
Bulletin 262-R. Spray Ponds.
Bulletin 255-R. Air Filters.
Bulletin 277-R. Air Washers.

THE COOLING TOWER COMPANY, INC.

15 JOHN STREET NEW YORK

Local Representatives:

Houston, Texas — The J. A. Rossiter Co., 410 Union Nat'l Bank Bldg.
Shreveport, La. — Pelican Well Tool & Supply Co.
Tulsa, Okla., — N. M. Muir, Kennedy Bldg.
Los Angeles, Calif., — N. O. Fleming Co., 5815 Maywood Ave., Huntingdon Park

Representatives in Other Principal Cities.

One of our spray nozzle cooling systems in operation at an oil refinery in Louisiana.

WYOMING REFINERY RUMORED

Cody, Wyoming.—According to a report which has not been verified, a refinery to be built here is contemplated. The current rumor is to the effect that the plant will be built by the Royal Dutch Shell, and that a representative of those interests was in Cody recently and made tentative arrangements for a refinery site.

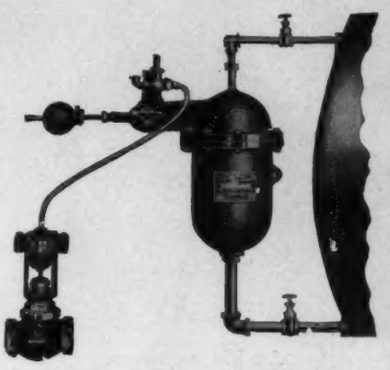
Electrically Driven Centrifuges
Hand Centrifuges
WRITE
WILLIAMS, BROWN & EARLE, Inc.
Manufacturers of Laboratory Apparatus
918 Chestnut St. Philadelphia, Pa.

BONER & SHELDON
Manufacturing Engineers
Fractionating Towers, Absorption Towers, Vertical Stills, Distillation Equipment.
514 Merchants National Bank Bldg.
Los Angeles, Cal.

RECLAIMED ARA PROOF-TESTED TANK AND FREIGHT CAR PARTS
TANK CARS BOUGHT, SOLD AND LEASED
BRIGGS & TURIVAS
110 S. Dearborn St., Chicago.
PLANTS: Blue Island and Chicago Heights, Illinois, and Pittsburgh, Pa.

THE VIGILANT OIL LEVEL REGULATOR

for any type of absorber or steam still.



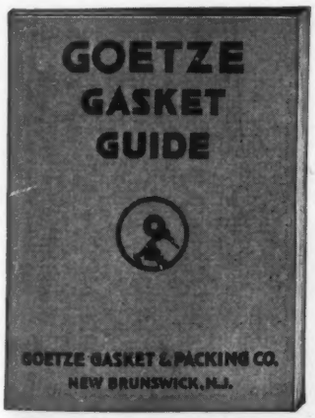
In the process of manufacture of gasoline by absorbing the gasoline in oil and subsequently separating the gasoline from the oil by distillation, it is essential that a constant oil level in both the absorbing tank and the still be maintained.

For this purpose the Vigilant Oil Level Regulator is manufactured. It is adaptable to any type of absorber or steam still and will maintain a constant oil level under all conditions of temperature and pressure.

For 25 years Chaplin-Fulton equipment has been recognized for accuracy and reliability

The Chaplin-Fulton Mfg. Co.
28-24 Penn. Ave. Pittsburgh, Pa.

GOETZE



Metal-Asbestos Gaskets
for
Modern Refinery Practice

Write for this 36-page "Guide"

Goetze Gasket & Packing Co.
28 Allen Ave., New Brunswick, N. Y.

Ac-Me Lookbox

Recording Gravitometer. Gas Gravity Balance. 100-Inch Water Column. Pressure & Vacuum Pump. Lookboxes. Vapor Tension Bomb. Loading Dome Covers. Calculators for Orifice Meters.

Announcement

The Refinery Supply Company has purchased the Ac-Me Company and will continue the manufacturing of all Ac-Me products.
In addition a department will be installed for repair work on Hays Gas Analyzers and Meriam Manometers.

Operating as
The R-S Manufacturing Co.
3408 MAIN STREET
DALLAS, TEXAS

THE SERVICE ACCURACY R.S.C. TULSA

The Refinery Supply Co.
TULSA, OKLA. DALLAS, TEXAS

For Protection

When paint spraying outside work use the New Improved Pulmosan Dustproof Aluminum Respirator.

For painting inside of tanks and tank cars use the Pulmosan Airline Mask with blower attachment.

Write for Descriptive Literature

Pulmosan Safety Equipment Corp.
384 Jay Street Brooklyn, N. Y.

A. P. I. Names Committee on Refinery Technology

New York. — American Petroleum Institute headquarters has recently sent out bulletins naming a general committee on refinery technology. Functions of the committee are as follows, according to the circular: To aid in providing a forum on refinery technology at the meetings and under the auspices of the American Petroleum Institute in conformity with the action of the board of directors on the recommendation of the Committee on Technical Relationships, and to advise the executive officers and technologists of the Institute with regard to all problems on refinery technology which the Institute is called upon to consider or act upon. Membership of the committee follows:

E. W. Isom, Sinclair Refining Company, 45 Nassua Street, New York, chairman; N. E. Loomis, Standard Oil Company of New Jersey, Elizabeth, New Jersey, vice-chairman; R. P. Anderson, American Petroleum Institute, secretary; D. T. Brandt, Henry L. Doherty Company, New York; C. B. Buerger, Gulf Refining Company, Pittsburgh, Pennsylvania; H. W. Camp, Empire Refineries, Inc., Okmulgee; S. P. Coleman, Humble Oil & Refining Company, Houston; O. P. Cottrell, Associated Oil Company, Associated, California; T. G. Delbridge, The Atlantic Refining Company, Philadelphia; S. H. Diggs, Mid-West Refining Company, Casper; R. A. Halloran, Standard Oil Company of California, San Francisco; E. T. Hanlon, Chestnut & Smith Corporation, Tulsa; Frank Holstein, Barnsdall Refining Company, Tulsa; E. R. Lederer, Texas-Pacific Coal & Oil Company, Ft. Worth; K. G. Mackenzie, The Texas Company, New York; W. D. Mason, Sun Oil Company, Philadelphia; R. R. Matthews, Roxana Petroleum Corporation, St. Louis; Walter Miller, Marland Refining Company, Ponca City; G. G. Oberfell, Phillips Petroleum Company, Tulsa; R. C. Osterstrom, Pure Oil Company, Chicago; L. W. Parsons, Tide Water Oil Company, Bayonne, New Jersey; D. Pyzel, Shell Company of California, San Francisco; F. A. Pielsticker, Skelly Oil Company, El Dorado, Kansas; J. B. Rather, Standard Oil Company of New York, Brooklyn; W. F. Sims, Panhandle Refining Company, Wichita Falls; W. L. Stewart, Jr., Union Oil Company of California, Los Angeles; L. B. Van Leuven, Vacuum Oil Company, New York; R. E. Wilson, Standard Oil Company (Indiana), Whiting, Indiana; W. S. Zehrung, The Pennzoil Company, Oil City Pennsylvania.

OPERATING NEW PLANT

Humble Oil & Refining Company has completed its new 5000-barrel daily capacity plant at San Antonio, Texas, and is operating it at full capacity on West Texas crude.